

INTERNATIONAL INSTITUTE OF AGRICULTURE
BUREAU OF AGRICULTURAL INTELLIGENCE AND PLANT DISEASES

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THE INTERNATIONAL INSTITUTE OF AGRICULTURE

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The Institute, always confining its attention to the international aspect of the various questions concerned, shall :

(a) collect, study and publish as promptly as possible, statistical, technical, or economic information concerning farming, vegetable and animal products, trade in agricultural produce, and the prices prevailing in the various markets ;

(b) communicate the above information as soon as possible to those interested ;

(c) indicate the wages paid for farm work ;

(d) record new diseases of plants which may appear in any part of the world, showing the regions infected, the progress of the diseases, and if possible, any effective remedies :

(e) study questions concerning agricultural co-operation, insurance and credit from every point of view ; collect and publish information which might prove of value in the various countries for the organization of agricultural co-operation, insurance and credit ;

(f) submit for the approval of the various governments, if necessary, measures for the protection of the common interests of farmers and for the improvement of their condition, utilizing for this purpose all available sources of information, such as resolutions passed by international or other agricultural congresses and societies, or by scientific and learned bodies, etc.

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ARGENTINA.

Boletines de la Sociedad rural argentina. Buenos Aires.
Anuario de la Dirección general de Estadística. Buenos Aires.
Anuario estadístico. República Argentina. Buenos Aires.
Argentine (The) Year-Book. London.
Boletín mensual del Museo Social Argentino y Boletín bibliográfico mensual (anexo al Bol. mens. d. Museo Soc. Arg.). Buenos Aires.
Campo (El). Buenos Aires.
Comercio (El) exterior argentino. Buenos Aires.
Faceta rural. Buenos Aires.
Industria (La) lechera. Buenos Aires.
Ministerio de Agricultura de la Nación. Dirección general de Enseñanza e Investigaciones agrícolas: 1. *Boletín.* — 2. *Circulares.* — 3. *Publicaciones.* Buenos Aires.
Ministerio de Agricultura de la Nación. — *Dirección general de Minas, Geología e Hidrología, Boletín.* Serie A: Minas, Serie B: Geología, Serie C: Hidrología y Perforaciones, Serie D: Química mineral y Aguas minerales, Serie F: Informes preliminares y Comunicaciones. Buenos Aires.
Monitor de Sociedades anónimas y Patentes de Invencción. Buenos Aires.
Publicación del Museo agrícola de la Sociedad rural argentina. Buenos Aires.
Review (The) of the River Plate. Buenos Aires.
Revista de la Facultad de Agronomía y Veterinaria. La Plata.

Revista del Centro Estudiantes de Agronomía y Veterinaria de la Universidad de Buenos Aires. Buenos Aires.
Revista de Ciencias Económicas. Buenos Aires.
Revista (La) de la Liga agraria. Buenos Aires.
Revista Forestal. Buenos Aires.
Revista de la Sociedad rural de Córdoba. Córdoba.
Universidad de Tucumán: 1) *Extensión agrícola. Boletín.* — 2) *Informe del Departamento de Investigaciones industriales.* Tucumán.

AUSTRALIA.

Agricultural (The) Gazette of New South Wales. Sydney.
Annual Report. Department of Agriculture and Industries of Western Australia. Perth.
Annual Report. Department of Lands and Survey. South Australia. Adelaide.
Annual Report. Papua. Melbourne.
Annual. Royal Agricultural Society of New South Wales. Sydney.
Australian (The) Farm & Home. Melbourne.
Australian Museum. Records. Sydney.
Australian (The) Sugar Journal. Brisbane.
Australian (The) Zoologist. Sydney.
Bulletin of the Department of Agriculture, Western Australia. — *Idem:* Division of Botany and Plant Pathology, Entomological Section. Perth.

Bulletin of the Department of Intelligence, South Australia. Adelaide.
Chemist (The), Druggist and Pharmacist of Australasia. Melbourne.
Fruit (The) World of Australasia. Melbourne.
Government Gazette of Western Australia. Perth.
Institute of Science and Industry. Bulletin. Melbourne.
Journal of the Department of Agriculture of South Australia. Adelaide.
Journal of the Department of Agriculture of Victoria. Melbourne.
Land (The). Sydney.
Motor (The) in Australia. Sydney.
New South Wales. Department of Agriculture: 1. Farmers' Bulletin. — 2. Science Bulletin. Sydney.
New South Wales (The) Industrial Gazette. Sydney.
Pastoral (The) Review. Melbourne.
Producer's Review. Perth.
Quarterly Summary of Australian Statistics. Melbourne.
Queensland (The) Agricultural Journal. Brisbane.
Queensland. Bureau of Sugar Experiment Stations. Division of Entomology: 1. Bulletin — 2. General Series Bulletin. Brisbane.
Queensland Government Gazette. Brisbane.
Queensland (The) Industrial Gazette. Brisbane.
Report. Agricultural and Stock Department. Parliament of Tasmania. Hobart.
Science and Industry. Melbourne.
South Australia. Department of Agriculture. Bulletin. Adelaide.
South (The) Australian Government Gazette. Adelaide.
Tasmania Agricultural and Stock Department. Bulletin. Hobart, Tasmania.
Victorian Year Book. Melbourne.
Western Australia Year Book. Perth.
Year Book (The Official) of New South Wales. Sydney.
Year Book (Official) of the Commonwealth of Australia. Melbourne.

AUSTRIA.

Akademie der Wissenschaften. Sitzungen der mathematischen-naturwissenschaftlichen Klasse. Wien.
Allgemeine Wein-Zeitung. Wien.
Ämtliche Veterinärnachrichten. Wien.
Berichte aus den neuen Staaten. Wien.

Centralblatt für das gesamte Forstwesen. Wien.
Jahrbuch der geologischen Reichsanstalt. Wien.
Jahrbuch der Landwirtschaftsgesellschaft in Wien. Wien.
Jahrbuch der österreichischen Industrie. Wien.
Jahresbericht der Samenkontroll-Station in Wien. Wien.
Jahrbücher der zentral-Anstalt für Meteorologie und Geodynamik. Offizielle Publikation. Wien.
Land- und volkswirtschaftliche Mitteilungen. Linz.
Landwirtschaftliche Mitteilungen für Kärnten. Klagenfurt.
Milchwirtschaftliche Zeitung. Wien.
Mitteilungen der deutschen Landwirtschaftsgesellschaft in Brünn. Brünn.
Oesterreichische Fischerei-Zeitung. Wien.
Statistisches Jahrbuch des Ackerbauministeriums. Wien.
Verhandlungen der geologischen Reichsanstalt. Wien.
Wiener allgemeine Forst- und Jagd-Zeitung. Wien.
Wiener landwirtschaftliche Zeitung. Wien.
Zeitschrift des Österr. Ingenieur u. Architekten-Vereines. Wien.
Zeitschrift für das landwirtschaftliche Versuchswesen in Deutschösterreich. Wien.
Zeitschrift für Garten- und Obstbau. Wien.

BELGIUM AND BELGIAN CONGO.

Académie royale de Belgique. Bulletin de la Classe des Sciences. Bruxelles.
Agronomie (L') tropicale. Uccle-lez-Bruxelles.
Annales de Gembloux. Bruxelles.
Annales de l'Observatoire royal de Bruxelles, publiés aux frais de l'Etat et Annuaire météorologique. Bruxelles.
Annales de Médecine Vétérinaire. Bruxelles.
Annales des Travaux publics de Belgique. Bruxelles.
Annales du Musée du Congo belge. (Ministère des Colonies). Bruxelles.
Annuaire de la Belgique scientifique, artistique et littéraire. Bruxelles.
Annuaire de l'Institut international de Bibliographie. Bruxelles.
Annuaire officiel. Ministère des Colonies. Bruxelles.

Annuaire statistique de la Belgique et du Congo belge. Bruxelles.

Belgique horticole, agricole et avicole. Bruxelles.

Belgique (La) maritime et coloniale. Bruxelles.

Bibliographie de Belgique :

Première Partie : Bulletin mensuel des Publications belges ou relatives à la Belgique.

Seconde Partie : Bulletin mensuel des articles de fond parus dans les revues belges. Bruxelles.

Boer (De). Leuven.

Boerin (De). Leuven.

Bulletin agricole du Congo Belge. Bruxelles.

Bulletin de Documentation économique. Bruxelles.

Bulletin de la Société centrale forestière de Belgique. Bruxelles.

Bulletin de la Société chimique de Belgique et Bulletin de la Fédération des Industries chimiques de Belgique. Bruxelles.

Bulletin de l'Association des Planteurs de Caoutchouc. Anvers.

Bulletin de la Société Royale Linnéenne de Bruxelles. Bruxelles.

Bulletin d'Informations agricoles. Bruxelles.

Bulletin du Jardin Botanique de l'Etat à Bruxelles. Bruxelles.

Bulletin mensuel de la Commission permanente Belge du Lait. Malines.

Bulletin mensuel du Commerce spécial de la Belgique avec les Pays étrangers. Bruxelles.

Bulletin officiel du Congo Belge. Bruxelles.

Chasse et Pêche. Bruxelles.

Congo. — Revue générale de la Colonie belge. Bruxelles.

Déjense (La) agricole belge. Bruxelles.

Ingénieur (L') textile. Wesny-Andrimont-lez-Verviers.

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Mercuriales (Les) agricoles. Anverse.

Moniteur (Le) horticole belge. Bruxelles.

Progrès (Le) agricole belge. Jodoigne.

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WEIGHTS, MEASURES AND MONEY OF THE VARIOUS COUNTRIES WITH THEIR ENGLISH EQUIVALENTS.

Archine (Russia)	=	27.99961 inches
Ardeb (Egypt)	=	5.44435 bushels
Ardeb of wheat (Egypt)	=	2.95264 cwt.
Ardeb of hulled maize (Egypt)	=	2.75580 cwt.
Ardeb of barley (Egypt)	=	2.36211 cwt.
Ardeb of uncorticated rice (Egypt)	=	5.72812 cwt.
Ardeb of decorticated rice (Egypt)	=	3.83813 cwt.
Arpent (Canada)	=	0.84501 acres
Are [100 square metres]	=	107.63915 square feet
Arroba (Brazil)	=	33.06951 lbs.
Arroba (Cuba, Guatemala, Paraguay, Peru)	=	25.35841 lbs.
Arroba (Mexico)	=	25.36617 lbs.
Bale of cotton (Brazil)	=	396.83415 lbs.
Bale of cotton (United States)	=	4.40431 cwt. (gross wt.)
" " " " "	=	4.26788 cwt. (net wt.)
Bale of cotton (India)	=	3.57145 cwt.
Barrel of wheat flour (Canada, United States)	=	1.75001 cwt.
Bar, see Millier		
Bow (Java, Dutch Indies)	=	76.36998 square feet
Bushel (United States)	=	0.06896 bushels
Bushel of oats (United States)	=	32 lbs.
Bushel of oats (Canada)	=	34 lbs.
Bushel of wheat and potatoes (United States)	=	60 lbs.
Bushel of barley (Canada, United States)	=	48 lbs.
Bushel of raw rice (United States)	=	45 lbs.
Bushel of rye, hulled maize, linseed (Canada, United States)	=	56 lbs.
Cadastral arpent (Hungary)	=	1.42201 acres
Cental (United States)	=	100 lbs.
Centiare [10 square metres]	=	10.76392 square feet
Centigramme	=	0.15432 grains
Centilitre	=	0.0022 gallons
Centimetre	=	0.393715 inches
Centistere	=	0.35315 cubic feet
Centner (Germany, Austria, Denmark)	=	110.23171 lbs.
Centner (Sweden)	=	93.71238 lbs.
Cho [60 ken] (Japan)	=	119.30327 yards
Cho (Japan)	=	2.45068 acres
Crown [100 heller] (Austria-Hungary)	=	10 d at par
Crown [100 öre] (Denmark, Norway, Sweden)	=	1s 1 1/4 d at par
Cubic centimetre	=	0.06102 cubic inches
Cubic metre	=	1.30795 cubic yards
Decagramme [10 grammes]	=	0.35275 oz.

LX WEIGHTS, MEASURES AND MONEY OF THE VARIOUS COUNTRIES

1 Decalitre [10 litres]	= 2.19976 gallons
1 Decametre [10 metres]	= 32.80840 feet
1 Decare [1000 square metres]	= 1195.98627 square yards
1 Decastere [10 cubic metres]	= 13.07931 cubic yards
1 Deciare [10 square metres]	= 11.95986 square yards
1 Declatine [2 tochetwert] (Russia)	= 2.69966 acres
1 Decigramme	= 1.54323 grains
1 Decilitre	= 0.022 gallons
1 Decimetre	= 0.0027497 bushels
1 Decistere	= 3.93701 inches
1 Dinar, gold [100 para] (Serbia)	= 3.53146 cubic yards
1 Dollar, gold, \$ [100 cents] (United States)	= 9 ¹¹ / ₁₆ d at par
1 Drachm, gold [100 lepta] (Greece)	= 4 s 1 ¹ / ₁₆ d at par
1 Dz. = Doppelzentner (Germany)	= 9 ¹¹ / ₁₆ d at par
1 Egyptian kantar (Egypt)	= 220.46341 lbs.
1 Feddan Masri [24 Kirat Kamel] (Egypt)	= 99.04980 lbs.
1 Florin, gold, or Gulden [100 cents] (Netherlands)	= 1.03805 acres
1 Franc [100 centimes] (France)	= 1 s 7 ¹¹ / ₁₆ d at par
1 Gallon (United States)	= 9 ¹¹ / ₁₆ d at par
1 gramme	= 0.83270 gallons
1 Hectare [10 000 square metres]	= 0.03527 oz.
1 Hectogramme (100 grammes)	= 2.47109 acres
1 Hectolitre [100 litres]	= 3.52746 oz.
1 Hectometre [100 metres]	= 21.99755 gallons
1 Hectostere [100 cubic metres]	= 2.74967 bushels
1 Jarra (Mexico)	= 109.36133 yards
1 Kadastral hold, see Cadastral arpent	= 130.79505 cubic yards
1 Kin (Japan)	= 7.22642 quarts
1 Kokou [10 to] (Japan)	—
1 Kokou of oats (Japan)	= 1.32278 lbs.
1 Kokou of cocoons (Japan)	= 1.58726 quarts
1 Kokou of wheat and maize (Japan)	= 1.55014 cwt.
1 Kokou of barley (Japan)	= 82.67268 lbs.
1 Kokou of naked barley (Japan)	= 2.58356 cwt.
1 Kokou of rice (Japan)	= 2.06685 cwt.
1 Kopek (Russia)	= 2.69428 cwt.
1 Kwan (Japan)	= 2.80501 cwt.
1 Lei, gold [100 bani] (Rumania)	= 1 ¹ / ₁₆ farthing at par
1 Leu [100 statinki] (Bulgaria)	= 8.26738 lbs.
1 Lira [100 centesimi] (Italy)	= 9 ¹¹ / ₁₆ d at par
1 Litre	= 9 ¹¹ / ₁₆ d at par
1 Manzana (Nicaragua, Guatemala)	= 0.21998 gallons
1 Mark [100 Pfennige] (Germany)	= 0.0275 bushel
1 Mark [100 penni] (Finland)	= 1.72665 acres
	= 11 ¹ / ₁₆ d at par
	= 9 ¹¹ / ₁₆ d at par

Maud Factory (India)	= 74.6709 lbs.
Maund Imperial (India)	= 82.28136 lbs.
Metre	= 3.28084 feet
Milliare	= 1.07639 square feet
Milligramme	= 0.01543 grains
Millilitre	= 0.00022 gallons
Millimetre	= 0.03937 inches
Millistere	= 61.02361 cubic inches
Myriagramme [10 000 grammes]	= 22.04634 lbs.
Myrialitre [10 000 litres]	= 2 199.75539 gallons
Myriametre [10 000 metres]	= 274.96701 bushels
Millier [1 000 000 grammes]	= 6.21373 miles
Milreis, gold (Brazil)	= 19.68426 cwt.
Milreis, gold (Portugal)	= 28 2 ¹¹ / ₁₆ d at par
Minot (Canada)	= 48 5 ¹¹ / ₁₆ d at par
Morgen (Cape of good Hope)	= 1.07306 bushels
Muid (Cape of good Hope)	= 2.11654 acres
	= 24 gallons
	= 3 bushels
Okka (Greece)	= 2.75579 lbs.
Oke (Egypt)	= 2.75138 lbs.
Peseta, gold [100 céntimos] (Spain)	= 9 ¹¹ / ₁₆ d at par
Peso, gold [100 centavos] (Argentina)	= 38 11 ¹¹ / ₁₆ d at par
Peso, gold [100 centavos] (Chili)	= 18 5 ¹¹ / ₁₆ d at par
Pic (Egypt)	= 2.46646 feet
Pikul (China)	= 133.27675 lbs.
Pikul (Japan)	= 132.27805 lbs.
Poud (Russia)	= 36.11292 lbs.
Pound, Egyptian, gold [100 piastres]	= £1.0.6 ¹¹ / ₁₆ d at par
Pound, Turkish, gold [100 piastres] (Ottoman Empire)	= 188 0 ¹¹ / ₁₆ d at par
and (Sweden)	= 0.93712 lbs.
Quintal	= 1.96843 cwt.
Rouble, gold [100 kopeks] (Russia)	= 28 1 ¹¹ / ₁₆ d at par
Rupiah, silver [16 annas] (British India)	= 18 4 d at par
Square metre	= 1.19599 square yards
Stere [1 cubic metre]	= 1.30795 cubic yards
Socro, silver (Ecuador)	= 18 11 ¹¹ / ₁₆ d at par
Talari [20 piastres] (Egypt)	= 48 1 ¹¹ / ₁₆ d at par
Tan (Japan)	= 0.49601 bushels
	= 3.96815 gallons
Ton (metric)	= 0.98421 tons
Verst (Russia)	= 1166.64479 yards
Yen, gold [2 fun or 100 sen] (Japan)	= 28 0 ¹¹ / ₁₆ d at par
Zentner (Germany)	= 110.23171 lbs.

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INTERNATIONAL INSTITUTE OF AGRICULTURE
BUREAU OF AGRICULTURAL INTELLIGENCE AND PLANT DISEASES

INTERNATIONAL REVIEW OF THE SCIENCE
AND PRACTICE OF AGRICULTURE

MONTHLY BULLETIN
OF AGRICULTURAL INTELLIGENCE AND PLANT DISEASES

ABSTRACTS

AGRICULTURAL INTELLIGENCE

GENERAL INFORMATION.

- 1 - The Effect of a Variation in Milling on the Digestibility of Wheat Flours. —
LANGWORTHY, C. F. and HOLMES, A. D., in *Proceedings of the National Academy of Sciences of the United States of America*, vol. 7, No. 4, pp. 119-123, Washington, April 1921.

HYGIENE

The shortage in the World's food-supply in 1917 made the collection and correlation of data concerning human nutrition of the outmost importance and many questions were re-examined in the hope of providing additional data of value.

Extensive investigations into the chemical composition, digestibility and nutritive value of wheat and wheat products have already been made by European investigators and in the United States (1). Investigations made by the Office of Home Economics of the U. S. Department of Agriculture undertaken with the co-operation of the Maine and Minnesota Agricultural Experiment Stations included studies in the digestibility of wheat flours prepared in a variety of milling conditions from wheat grown in similar climatic, seasonal and soil conditions. The results obtained showed that the protein of white flour (72 % extraction) was 88.1 % digested; that of entire wheat flour (85 % extraction) was 81.9 % digested, and that of graham flour (100 % extraction) was 76.9 %.

In 1917, the U. S. Food Administration requested the Office of Home Economics to obtain additional data concerning the relative digestibility

(1) U. S. Department of Agriculture, Office Expt. Stations Bulletin 85 (1900); 101 (1901); 96 (1903); 143 (1904); 156 (1905).

of flours representing a series of extractions from the same lot of wheat. The flours studied were prepared from the wheat mixture provided to the flour-millers by the U. S. Grain Corporation late in 1917 and consisted of the following: choice hard spring (largely Marquis), 20 % — spring, 25 % — velvet chaff, 15 % — slightly smutty spring, 25 % — durum, 10 % — Kansas and Oklahoma, 5 %. The milling rates adopted were: 54-70-85-100 % of wheat or in other words the flours were those known in commerce as "patent", "standard patent", "whole wheat" and "graham". The digestibility tests were conducted with healthy young men, of whom some were accustomed to much and others to comparatively little exercise: There were 139 of these tests and the experimental periods were from 15 to 25 days in length and subdivided and regarded as separate and successive three-day experiments. The diet consisted of bread, oranges, sugar with tea or coffee. The following table summarizes the results.

Summary of Experiments on the Digestibility of Wheat Flours.

Kind of flour used	Number of experiments	Amount of bread eaten per man per day Grammes	Digestibility of entire ration			Digestibility of Bread Protein Per cent	Digestibility of Bread Carbohydrate Per cent
			Protein	Fat	Carbohydrate		
			Per cent	Per cent	Per cent		
54 % flour	43	600	87.8	96.5	98.8	87.7	99.7
70 % " "	42	564	90.1	96.1	99.0	90.1	99.9
85 % " "	21	472	87.1	96.9	97.5	87.1	98.5
100 % " "	33	663	84.2	93.9	95.0	84.2	94.4

Thus the maximum of digestibility was shown by the 70 % flour, that of the 54 % flour was slightly greater than that of the 85 % flour, while the digestibility of the 100 % flour was the lowest. The results are in accord with those obtained in earlier experiments. The fat content of the diet was equally well digested, digestibility being almost complete, except in the case of the 100 % flour, when it reached 93.9 % only.

The 54 % and 70 % flours did not tend to produce constipation; the 85 % and 100 % flours produced a somewhat freer movement of the bowels but no marked laxative effect was noticed.

2 - The "Bacteriophagous" Microbe (1). -- D'HERELLE, F., in *La Nature*, No. 2178, pp. 219-222. Paris, Oct. 1, 1921.

An account, for general use, of the present state of information with regard to the bacteriophagous microbe discovered by the Author, who makes the following statement:

(1) Several Studies on the bacteriophagous microbe were analysed in R. April 1920, No. 439 and R. April 1921, No. 399. — Others have appeared in the *Comptes rendus de la Société de Biologie*, Vol. LXXIV, 1921, pp. 3. (F. WOLLMAN). — 5 (L. MARTIN) — 275, 754, 751, 753, 755 (A. GRATIA) — 276, 278, 280, 743, 747, 748 (J. BORDET and M. CIUOA) — 359, 384, 538, 863, 908 (F. D'HERELLE) — 467, 468, 755 (J. MAISIN) — 798 (G. ELIAVA and E. POZERSKI) — (F. D'HERELLE and E. ELIAVA) — 817 (R. BRUYNOCHE and J. MAISIN). (F.d.)

"The facts observed in bacillary dysentery are the following.

A sample of the dejecta are taken for each day from the onset of the malady till the end of convalescence. Each sample is mixed with broth and passed through a Chamberland filter: all the microbes which can be seen under the microscope remain in the filter, the filtered liquid is clear and remains so indefinitely if preserved aseptically; it is apparently sterile.

For the sake of clearness, I take a chance example from the notes on a series of experiments.

The case of Victor Ker was tested during a period of 30 days, giving 30 samples of dejecta filtrate, one for each day.

Thirty tubes of dysentery bacillus culture are taken and a drop of each of the 30 filtrates added to each tube and all the tubes submitted to a temperature of 37° C in the stove. After twelve hours the following results are reached.

Tubes 1-6, no change; the broth is turbid as in the case of a normal culture of dysentery bacteria.

Tubes 7-18, perfectly clear.

Tubes 19-30, turbid as tubes 1-6.

Hence a strange phenomenon is to be noted in tubes 7-18; the dysentery bacteria have been dissolved without leaving a trace. How has this been caused? It cannot be the drop of added filtrate. It is to be concluded that from the seventh to the eighteenth day the patient's dejecta contained some element which destroys and dissolves the dysentery bacteria.

If we now enquire whether there is any correlation between the state of the patient and the presence of the solvent principle in the excreta, we see that from the seventh day onwards the blood has disappeared from the stools and the patient's condition has rapidly improved; by the eighteenth day the cure was complete. The presence of the solvent principle has been coincident with the cure: an investigation of a large number of cases has shown that the phenomenon is constant, not only in bacillary dysentery but also in typhoid, fowl typhus and even in maladies without intestinal symptoms, such as hemorrhagic septicaemia in buffaloes and bubonic plague.

If the filtrate containing the principle which dissolves the dysentery bacteria is again examined and an infinitesimal quantity of the culture added instead of a drop — for example a thousand millionth part of a cubic centimetre, — after a few hours the bacilli are as completely dissolved as with a drop. What then is the nature of this bacteriocidal principle whose action is many thousand times more effective than any antiseptic, however powerful?

If a trace of the culture of dysentery bacilli which has become clear as a result of the action by the filtrate is taken and introduced into a new, very turbid culture of the same bacillus within a few hours this second culture becomes clear and all the bacilli are dissolved. If a trace of this second dissolved culture is introduced into a third, this is in its turn dissolved also and the series can be continued indefinitely; for example a trace of the 1000th dissolved culture causes dissolution in the 1000th. Hence the principle which dissolves the bacteria reproduces itself and develops as a living germ."

If the culture of dysentery bacilli in the limpid state is examined under the highest form of microscopic enlargement, no microbe is visible. The principle which dissolves the bacteria is a microbe of extreme minuteness, which escapes the closest filtration and is invisible under the microscope, an ultra-microbe in a word. These ultra-microbes are enumerated in the following manner:

Ten cubic centimetres of a broth culture rich in dysenteric bacilli are taken to which is added the filtrate containing the dissolvent principle so diluted as to contain one fiftieth thousandth part of a cubic centi-

metre of the filtrate; this is shaken vigorously and immediately a hundredth part of a cubic centimetre is exposed uniformly on the surface of a solid tube. After heating in the stove at a temperature of 37° C. a layer of bacilli will be found on the solid medium, interspersed with 50 small circular fields in which the bacilli are dissolved. Each field represents a focus for the dissolution of bacilli, that is to say an ultra-microbe originally developed. This method of enumeration is the basis of all the experiments which have enabled the Author to study the activities of the ultra-microbe and to determine its function.

The result so far obtained may be briefly summarized as follows:

The principle which dissolves the microbes is an extremely minute ultra-microbe: its volume might be regarded as equivalent to that of a molecule of albumen. It is named by the Author *Bacteriophagum intestinale* or more simply "bacteriophage" and is itself a dependent parasite only able to develop at the expense of living bacteria which it penetrates by means of its property of secreting dissolvent principles. It reproduces itself after penetration into a bacterium; utilizing for its growth the substance dissolved from the bacterium, it forms a colony of 15 to 25 elements. The bacterium gradually swells, assumes a globular form and then bursts, thus liberating the young ultra-microbes, each of which in turn becomes parasitic on a fresh bacterium.

There is only a single type of bacteriophagous microbe, which through habituation can become parasitic for a very large number of species of bacteria, quite possibly for all bacteria. Up to the present the Author has identified it in parasitic stocks for very different species:— the bacilli of dysentery, typhoid fever, plague and staphylococcus to name only typical bacteria of human diseases. The faculty possessed by the bacteriophagous microbe of becoming parasitic for different species of bacteria corresponds precisely with the acquisition of a "virulence" which can be enhanced or diminished *in vitro*.

The normal habitat of the bacteriophagous microbe is the intestine and the Author has found it in the contents of the intestine of all the healthy animals he has examined both vertebrate and invertebrate. Here it lives at the expense of the normal bacteria to be found in the host. When a strange bacterium is introduced into the intestine, the bacteriophagous microbe becomes habituated more or less rapidly according to conditions and becomes parasitical for the invading germ. If this germ is pathogenic, the fate of the individual attacked depends upon the rapidity with which the bacteriophagous microbe becomes habituated. If habituation is immediate, the disease aborts before producing any morbid symptom; if delayed, the disease declares itself and the period of delay determines the duration of the illness. Convalescence begins only at the moment when the bacteriophagous microbe gets the mastery of the bacterium and if habituation does not take place at all the victim succumbs.

The question arises why is habituation sometimes retarded or checked. The answer is that environment exercises an influence upon the struggle favourable to one or other of the contending germs. For exam-

ple the bacteriophagous ultra-microbe is more sensitive than the bacteria to the reaction of the environment ; it cannot resist a degree of alkalinity or acidity which the bacteria can withstand with practical impunity. There is also another element, primordial in character, which gives the other side of the question. The bacteriophagous microbe is capable of assuming the quality of " virulence " as against a bacterium, but the bacterium when attacked does not remain passive but defends itself and can acquire immunity. The stages of the struggle between the bacteriophagous microbe and the bacterium are precisely similar to the stages of the struggle between the bacterium and the higher organism on which it is parasitic. The disease bacterium secretes a toxin which acts upon the cells of the infected subject, which replies by developing an antitoxin. The bacteriophagous microbe secretes a dissolvent diastase, or lysine which acts upon the bacterium, which replies by developing an antily-sine ; thus there is merely a descent in the scale of the contending entities.

Protection by the bacteriophagous microbe is not confined to affections of the intestine ; the ultramicrobe can also enter the circulatory system and function at any point in the organism. For example the author in cases of convalescents has succeeded in isolating and making cultures of bacteriophagous microbe stocks which dissolve the bacillus of bubonic plague.

Briefly the history of a case of infectious disease is a reflection of the process of the struggle which takes place in the organism between a disease bacterium and the bacteriophagous ultra-microbe.

But this is not all : every convalescent from a contagious disease carries in the intestine bacteriophagous ultramicrobes working against the disease bacterium, and distributes them with his excreta. He can thus " infect " his neighbours and immunity is as contagious as the disease itself. The author has frequently discovered that at the end of an epidemic all susceptible subjects who have escaped the contagion carry in the intestine the bacteriophagous microbe in the active state and in this way the idea of " contamination " by the bacteriophagous microbe has been brought home to him.

Thus the history of an epidemic is in the final analysis the history of a struggle between two active forces : the disease microbe, which at the beginning develops freely, and the bacteriophagous microbe whose virulence against the bacterium increases in the case of patients where conditions are favourable. Such patients recover, distribute the bacteriophagous microbe in active condition and the epidemic comes to an end when all susceptible individuals give it shelter in their organism. These facts have been demonstrated by studies of different forms of animal distempers such as fowl typhus, hemorrhagic septicaemia of buffaloes and rat-plague : the two last diseases were investigated in the Far East.

Hence a new fact emerges : antimicrobial immunity is heterologous in the susceptible animal ; the defence of the organism is secured by an ultra-microbe, parasitical upon the bacteria.

But as has been seen this ultra-microbe can be cultivated *in vitro*

and it is therefore possible to obtain as many cultures as may be required. If the observations made are in fact accurate and a susceptible animal is assured of immunity from the moment when the bacteriophagous ultra-microbe becomes habituated to parasitism upon the disease-producing microbe which is trying to invade the organism, it ought to be possible to reproduce the phenomenon at will. In this case it will merely be necessary to introduce into the susceptible organism a culture of the bacteriophagous microbe which has become virulent for any particular bacterium to cause the organism to become immediately proof against the disease which it causes.

Experiments made in fowl typhus and hemorrhagic septicaemia of buffaloes have in fact established this principle, for they have shown that,—

a) in epidemic conditions a single injection of a minimum quantity of a culture of the bacteriophagous microbe active in relation to a given bacterium produced immunity from the disease caused by it from the moment of the injection.

b) in non epidemic conditions immunity was acquired only after an incubation period varying according to the dose injected. In the case of hemorrhagic septicaemia in the buffalo immunity is attained after twenty days with a dose of a quarter of a cubic centimetre. After the injection of a single drop a buffalo weighing 250 kg. became immune in four days.

Experiments in connection with the curative properties of the ultra-microbe have also been made on similar lines in 100 cases of fowl-typhus and later in 7 cases of human bacillary dysentery. These have proved that the injection or ingestion of a minimum quantity of a culture of the bacteriophagous microbe, developed at the expense of the disease-causing bacterium, checks the progress of the disease at once, provided of course, that it is introduced at a time sufficiently near to its first onset to secure that the organic lesions are not of themselves severe enough to bring about a fatal issue, for the function of the bacteriophagous microbe is confined to the destruction of the bacteria. It has been noted above that at the end of an epidemic all the susceptible individuals who have escaped contagion are carriers of the bacteriophagous microbe destructive to the bacterium which causes the disease. This conception makes it possible to consider the possibility of a collective protection. It would seem that this purpose would be fulfilled by diffusing in the drinking water cultures of the bacteriophagous microbe in a state of activity, there being ample experience to shew that it is absolutely harmless for all living beings.

In this way it could be made certain that the bacteriophagous microbe destructive of the cause of the epidemic would be present in the organism of all susceptible individuals during the whole of the critical period.

What light is thrown on the phenomenon of phagocytosis by these new facts?

A study of the phenomena of protection must deal with three different conditions of the subject :

- 1) The animal naturally resistant.
- 2) The susceptible animal that has acquired immunity either naturally following on an attack, or experimentally following a vaccine treatment.

The above are the two conditions which have been considered by METCHNIKOFF and his fellow workers. They have recognized that protection in these two cases is secured by phagocytosis. It still remains necessary to consider the means of protection for:—

- 3) The susceptible animal that does not, or does not as yet, enjoy immunity.

The two following questions require to be answered.

Susceptible animals exposed to contagion do not in all cases contract the disease: what are the means of protection possessed by those which escape?

An animal attacked by a contagious disease of bacterial origin is cured and thus obtains protection: what are its means of protection between the onset of the malady and the moment when this immunity is established? In fact why does the cure take place?

Experiments upon the bacteriophagous microbe suggest the answer to these questions.

The heterologous immunity produced by the bacteriophagous microbe does not take the place of the homologous cellular immunity, for it functions at a time when the latter is not active; the first is dominant in the susceptible animal, the second in the resistant.

3. New Institutes for Agricultural Experiment in Italy. — STRINGHER, V., in *Atti della R. Accademia dei Georgofili*, Series V, vol. XVIII, No. 2, pp. 64-82. Florence, April 1921 (7).

AGRICULTURAL
EXPERIMENTATION

An account of the establishment during recent years of Institutes for Agricultural Experiment, founded by various Agricultural Associations and placed under the general supervision of the Ministry of Agriculture.

The "Stazione agraria sperimentale" at Bari has been at work since 1919: its main objectives are as follows:

- a) The scientific study of the special problems of Agriculture in Southern Italy with particular reference to the application of physics, chemistry and biology thereto.
- b) Methods of protecting crops from vegetable and animal pests.
- c) The publication of practical information concerning crops and agricultural industries of special interest in Apulia.

The State, Province, Municipality and Chamber of Commerce of Bari all contribute to the maintenance of the Institute with a total annual contribution of 93 000 *lire*. The local authorities provided the building and site; in addition the Ministry of Agriculture made a grant of 640 000 *lire* for initial capital expenses.

(7) See R. Oct-Dec. 1919, No. 1074 (Ed).

The " Istituto sperimentale di meccanica agraria " at Milan was opened on June 10, 1920; its chief duties, which are both agricultural and industrial are the following:

a) To carry out studies and trials of machines and machine-plants used in agriculture, agricultural industries, soil improvement and irrigation either at the instigation of the Government or other Public Administrative Bodies, the request of manufacturers, etc., or on the direct initiative of the Institute.

b) The preparation of tests and the collection and coordination of essential elements in trials for juries at Competitions and Exhibitions of agricultural machinery.

c) Laboratory and open air research work leading to conclusions likely to be of assistance in the scientific and technical development of machines and machine-plants for agricultural industries.

d) The coordination of the work of the Institute with results obtained in similar institutions in other countries, by juries at Competitions and Exhibitions and by specialists, with reports thereon to the competent Ministries and to Institutions and other bodies interested.

e) To give technical advice with regard to machines, plant and agricultural industries.

The Ministry of Agriculture has made a grant of 100 000 *lire* for initial capital expenditure and allows 50 000 *lire* a year for maintenance. The Province and Municipality of Milan each make grants of 10 000 *lire* annually. It has however to be recognized that, in order to carry out its functions on the lines laid down, the Institute will require much larger subsidies and these are likely to be forthcoming.

A Government Decree of June 8, 1920, established the " Istituto nazionale di genetica per la cerealicoltura ". Its duties are to conduct experiments to discover the best varieties of cereals for the different districts of Italy and to arrange for their distribution to the farmers. The Institute will have a total sum of about 8 500 000 *lire* at its disposal.

The Institute will have under its administrative and technical control:

a) Phytotechnical stations with trial and initial multiplication plots for Apulia, Sicily and Latium (attached to the Institute);

b) Local observation and trial plots;

c) Multiplication plots;

d) Plots for the maintenance of pure seed lines with offices for distribution attached;

e) A museum of genetics at Headquarters.

The technical work of the " R. Stazione sperimentale di granicoltura " at Rieti will be coordinated with that of the new Institute.

The " Istituto di allevamento vegetale per la cerealicoltura " was originally founded at the " Scuola superiore di Agraria " at Bologna and recognized by the Ministry of Agriculture on June 10, 1920, which assigned to it a total annual subsidy of 50 000 *lire*. The special duties of this Institute are as follows:

1) Work for the improvement of the most important types of cereals grown in Italy, particularly wheat and kindred varieties ;

2) To bring about a more effective and complete employment of improved varieties :

a) by encouraging and carrying out, in cooperation with local agricultural associations and individual farmers, trials for the purpose of delimiting the most advantageous zone of culture for each variety ;

b) by encouraging and directing as occasion arises the local seed production in each zone so that as a general rule each district may be in the position of raising on its own soil the means of reproducing the selected varieties which it requires ;

3) To carry out from time to time selective tests in an appropriate milieu, of common established varieties of cereals at the request, or on behalf, of a contributory agricultural association ;

4) To complete the phytotechnical studies of the pupils of the Higher Agricultural School of Bologna by means of an appropriate practical and experimental apprenticeship.

The " Stazione sperimentale di maiscoltura " was founded at Bergamo on March 7, 1920, for the purpose of the improvement of maize culture and is mainly engaged on the following studies :

a) The physiology of the maize plant ;

b) Native and foreign varieties, selection and crossing ;

c) The value of the main product (grain) from the point of view of preservation, crushing and grinding, as food for men and cattle, industrial use (cake, alcohol, etc.) and as a marketable commodity ;

d) The waste products (stalks, straw, etc.) and how to use them to best advantage ;

e) The rotation systems best adapted to the crop, fertilizers, preparation of the soil, sowing and methods of cultivation, irrigation ;

f) The main difficulties in maize-culture and methods of control ;

g) Means of preserving the crops, etc.

A capital expenditure of 240 000 *lire* has been incurred and maintenance subsidies amount to 35 000 *lire*.

The station will also be in a position to deal with problems of selection for other cereals and especially for barleys for malting, and in addition experimental work on deterioration in maize will be undertaken.

The " Stazione sperimentale di Riscoltura " at Vercelli was started in 1908, and reorganized in 1917. It derives an annual income of 39 600 *lire* in addition to the premises and land required for the special work undertaken which is as follows :

a) To initiate, encourage and control experiments and demonstrations with the object of improving rice culture on a scientific basis so as to increase the value of the crop both in quantity and quality and also to improve other irrigated crops grown in rotation with rice ;

b) To keep abreast of the economics of rice-culture both at home and abroad, as a source of information and guidance to be communicated to farmers and other workers concerned, for the benefit of Italian production ;

c) To make contributions to the solution of the hygienic and social problems connected with rice culture ;

d) To make known by means of suitable peripatetic instruction the results of experimental and demonstrational work.

Funds amounting to 3 800 000 *lire* have recently been made available for this station.

The Experimental Station which was started at Lodi in 1871 was developed in 1919 into the "Istituto sperimentale di Caseificio". The main object of this Institute is to carry out scientific and technological enquiries into questions related to milk and its derivatives with reference both to its use as a food substance and also to the dairying industry in order to obtain precise and definite information. At the same time it will undertake experiments of all kinds calculated to establish the best technical results combined with the greatest economic advantages, and encourage the dissemination of modern ideas on the science and technique of milk production by means of occasional courses of instruction, conferences and publications. In addition to the half million *lire* allocated for capital expenditure, the Institute has a total annual subsidy of 50 000 *lire*.

The "Stazione sperimentale del freddo" annexed to the "R. Scuola superiore di Agricoltura" at Milan has been at work since July 1, 1913. Its functions include :

a) The examination, for purposes of comparison, of machinery, equipment and substances (especially non-conductive) used in the industry ;

b) The study of the application of artificial chilling, especially as regards the preservation of perishables and the treatment of agricultural produce ;

c) Enquiries into means of transport in cold storage and their organization from the point of view of food supply and problems of importation and exportation.

The Station has a total annual revenue of 18 000 *lire* together with a capital grant of 50 000 *lire* from the Ministry of Agriculture.

The "Stazione di batteriologia agraria" at Crema was instituted in 1914 and deals with the following questions :

a) The preparation and preservation of forage ;

b) The feeding of cattle from the point of view both of hygiene and production ;

c) The milk industry ;

d) Tobacco culture ;

e) The retting of flax and other plants used in the textile industry ;

f) The preparation and preservation of alcoholic beverages ;

g) The preservation of fruits, vegetables and animal products ;

h) Treatment by organic fertilizers ;

i) Microbial soil life with reference to its productivity and chemical constituents.

The Government makes an annual grant for maintenance of 30 000 *lire* and a group of local and district agricultural Associations makes a similar contribution. As a result of the contributions by different State

Departments and local Associations the Station is now definitely established and is about to spend 800 000 to 900 000 *lire* on the purchase of a farm with stallage for 50 to 60 cattle.

The " *Stazione sperimentale di pollicoltura* " at Rovigo was opened on June 28, 1917. The land and buildings and certain grants are provided by the Local Authorities and in addition the State made a contribution of 40 000 *lire* for initial expenditure and allows an annual grant of 25 000 *lire*. The scope of this Institution includes :

- a) The improvement of the most suitable breeds of birds, both local and imported, by means of crossing and selection ;
- b) The comparative study and the choice of breeds giving the best results as regard food value and egg production ;
- c) The study of the most scientific and economical methods of breeding ;
- d) The study of the diseases of poultry and the best means of prevention and cure ;
- e) Instruction and propaganda by means of short courses at the Institute, conferences and practical leaflets.
- f) All other forms of work and study, instructional and experimental, contributory to the economic development of poultry farming in Italy. Additional funds are to be allocated to the Institute by the Ministry of Agriculture.

Adequate grants have also been made to the following — the Laboratories of Agricultural Chemistry at the R. Scuola Superiore di Apicoltura at Milan and the R. Scuola superiore di Agricoltura at Portici ; the Laboratory of Chemical Agricultural Technology at the " R. Istituto Superiore agrario sperimentale " at Perugia, the Laboratory of Agricultural Chemistry at the " R. Scuola superiore di agricoltura " at Pisa and the independent Laboratories at Forlì and Udine.

In brief the Italian Government has, during the economic and financial crisis following on the war, made a liberal and comprehensive provision for Agricultural Experiment similar to that made when the first Institutes for experimental work in Agriculture were founded in Italy during the period from 1870 to 1872.

4 - Third International Congress of Household Economy Instruction, Paris, April 1922.

The International Federation for the development of Domestic Economy Teaching, which has its central Office at Fribourg (Switzerland), decided to hold in Paris, from the 18th to the 21st of April a 3rd International Congress of Household Economy Instruction with an Exhibition of equipment, material and methods. The two previous Congresses were held at Fribourg in 1908 and at Ghent in 1913.

A National French Committee has been formed in Paris for the local organization of this Congress with M. CHAMPETIER DE RIBES as Chairman and an office at 23 Rue Bertrand.

The following are the subjects for discussion at the Congress.

EXHIBITIONS,
MEETINGS,
CONFERENCES

General Scope: Organization, science and means of simplification of household work.

First Section.

GENERAL POSITION OF HOUSEHOLD ECONOMY INSTRUCTION.

- 1) *Household Economy Instruction in different Countries since the Ghent Congress.*
 - A. *Position immediately before the war.*
 - B. *Position during the war.*
Increased activity of women in national life through replacing men called up for military service. Observations made under these headings.
 - a) How have Household Economy Schools been carried on and worked during the War?
 - b) Have they been subsidized by the State or Municipality?
 - c) How have Household Economy Schools adapted themselves to the special conditions and what special services have they rendered, both national and local?
 - d) How far have members of the staff assisted in making good the shortage in food and fuel during the war?
 - e) Have the respective Governments and Local Authorities appreciated the services rendered and in what form has appreciation been expressed? — General results — marked development of women's sphere in political, economic and social life.
 - C. *Position at present time.*
General reconstruction. — The part of woman and of Household Economy Instruction (from the point of view of the simplification of household work).
- 2) *Household Economy Instruction in the Primary School.*
How and when should Household Economy Instruction be given to girls in the Primary School?
Is any form of special equipment necessary for this Instruction in the Schools in which it is provided?
If so, what should it be for town and country schools respectively?
- 3) *Household Economy Instruction as an integral formative element in the education and instruction of young girls of all classes.*
Should Household Economy Instruction be compulsory in Girls' Secondary Schools?
How and when should Household Economy Instruction be given in Girls' Secondary Schools?
Should each School be specially equipped for this Instruction?
What should be the equipment for Town and Country Schools respectively?
- Household Economy Instruction for boys.
- 4) *Correlation of Household Economy Instruction with home education.*
How to make parents appreciate the value of this Instruction?
- 5) *Correlation with Technical Education.*

- 6) *Professional Training for Household Economy Teaching.*
 a) How should courses for the scientific training of Teachers of Household Economy be organized?
 b) The importance of establishing a definite Teaching Service for Household Economy.
 c) The Pedagogy of Household Science. Should the instruction be individual, in classes with definite lessons or under the general direction of the Teacher.
 d) What should be the equipment for Household Economy Instruction in professional Training Colleges?
 e, The careers and prospects of Students in Household Economy Training Colleges?
 7) *Inspection of Household Economy Teaching. — Duties of the Inspectorate.*

Second Section.

TECHNICAL INSTRUCTION IN HOUSEHOLD SCIENCE.

- 8) *Rural Household Economy Schools.*
 Ways and means of making Household Economy Instruction really effective in rural areas.
 9) *Household Economy Instruction after the School age.*
 Civic duties of young girls. — Peripatetic Teaching. Child nurture.
 10) *Technical training of domestic servants in the family (with compulsory examination).*
 Present trend in direction of professionalism.
 11) *Inspection of Technical Instruction in Household Science.*

Third Section.

SCIENTIFIC QUESTIONS CONNECTED WITH HOUSEHOLD ECONOMY.

- 12) *Household Science at the University.*
 Introduction of questions relating to Household Science into the research work in University laboratories.
 13) *To what extent can Household Economy Schools assist in social betterment from the point of view of Working Class Housing, Food, Infant Hygiene, Cooperative Purchase and Consumption, High Prices and Adulteration?*

* * *

The general notice of the Congress is accompanied by an extract from the *Bulletin of the Swiss Union of Technical and Household Economy Mistresses*, No. 4, Fribourg, April 15, 1921, setting out the resolutions of the Congresses at Fribourg (1908) and at Ghent (1913) and dealing with the main questions on the Agenda for the Paris Congress. This extract may be summarized as follows:

HOUSEHOLD ECONOMY INSTRUCTION IN GENERAL. — As regards the place of woman and of Household Economy Instruction (as making

for the simplification of household work) the School should lay stress on the main lines to be followed and on the detailed organization of the work, showing how the various small actions in each branch can be distinguished and arranged in orderly sequence.

Household Economy Instruction in the Primary School. — Pupils must have the requisite development of intelligence and adequate elementary instruction. Organization must be based on local requirements and the special needs of each group of pupils.

The pupil should be instructed in the keeping of household accounts; in the country she should also be given a knowledge of the farm accounts which she will have to keep as mother of the family. At the same time she should have practice in making a ready reckoning of the net cost and nutritive value both of each dish and of each meal.

Household Economy work should not merely be grounded on knowledge derived from natural science courses, but practical household work should provide innumerable opportunities for the verification of scientific laws and incidental instruction in chemistry and physics.

Ideas on art should be suggested by the utensils, etc. in common use and the pupil taught to appreciate their beauty as well as the beauty of simple forms of ornament.

The equipment of a Household Economy School, whether in town or country, should as far as possible reproduce the home conditions of the majority of the pupils. The scheme of work and of the cookery course especially should be the main consideration. The school, even when in a town should give the pupil an idea of the economic and social importance of, the cultivation of flowers and vegetables, and for purposes of experiment and practical work there should be a garden attached.

Household Economy Instruction as an integral formative element in the education and instruction of young girls of all classes. — Household Economy Instruction for persons above the School age should be given to girls who remain at school after the elementary school period (in secondary or higher schools, special and technical). It is a matter of importance that the subject should be included in the examinations which confer a certificate of capacity for Elementary School Teaching. It is desirable that it should be made a compulsory subject with such variations as the particular circumstances of each country may require.

Correlation of Household Economy Instruction with home education. — The home ought to assist the teaching by encouraging regular attendance and providing opportunities for the pupils to put into practice the lessons learnt at school. In order to popularize Household Economy Instruction Parents' meetings should be held and demonstration courses for working class women given. The Household Economy School should impart healthy ideas on the facts of life and inspire enthusiasm for simple tasks.

Correlation with Technical Education. — The geometric system (based on personal measurements) should be adopted in instruction in cutting out and dress-making.

Professional Training for Household Economy Instruction. — Instruction should be given only by a mistress trained in a special Training College. Admission to such a college should be confined to girls who have obtained the elementary School Teachers' certificate or its equivalent and the minimum duration of the course should be for a year. The course should include instruction in Science (physics, chemistry, natural history) limited to its application to household work and in so far as it tends to make the students discover the rationale of the various processes included in their work. Rudiments of medical knowledge (hygiene, physiology and practical medicine) should be taught simultaneously in connection with discussions on the chief bodily organs and their functions. The more general instruction should be given by the staff, certain branches, such as child nurture and hygiene (human and animal) being entrusted to specialists.

The following methods for providing the teachers with the means of improving their knowledge are suggested: conferences or study circles; repeater or special courses; technical libraries. Criticism lessons also serve a very useful purpose.

The instruction both theoretical and practical, should be in groups and at the end of the course an examination should be held. The housework should be carried out, entirely if possible, by the students in training with the help of children in the last two years of the elementary school, working in groups under the orders of the students responsible and the general direction of the Principal in charge of the Household Economy Instruction. All the housework of the school which has educative value (maintenance of cleanliness and order, orderly and tasteful arrangement of furniture, general control of the work and conduct of the children) should be entrusted to the students themselves and carried out by them under the strict and regular control of the teaching staff.

The Household Economy Teachers' Training College can be more or less agricultural in character according to the special needs of particular countries.

TECHNICAL INSTRUCTION IN HOUSEHOLD ECONOMY. — The Household Economy School can be expected to serve to some extent as a beneficial influence in connection with rural depopulation and rural problems in general by giving women a high conception of their function, both social and occupational, as heads of the farm household.

Continuation School work should meet the needs of *a*) young girls on leaving the Elementary School; *b*) wage-earning women such as domestic servants, factory and work-room hands, shop-girls, clerks, etc.

It is to be hoped that employers of labour will be willing to allow a Household Economy Class to be formed in their factories or workshops for the benefit of their young women workers or that at least they will grant full facilities to their women workers and clerks to attend local classes.

Peripatetic courses should be given where it is not possible to have a permanent school.

SCIENTIFIC QUESTIONS CONNECTED WITH HOUSEHOLD ECONOMY. — Household Economy Schools can help in social betterment from the point

of view of Working Class Housing, Food, Infant Hygiene, Co-operative Purchase and Consumption, High Prices and Adulteration. The subjects of Instruction will include, rational feeding and vegetarian cookery; the campaign against Alcoholism, Tuberculosis and Infant Mortality; how to market; social and charitable work.

Finally among resolutions of a general character is included one urging that in all countries where Household Economy Teaching is left to private initiative, there should be a federation of Committees, each preserving its own individuality, in order that the work and the benefits to be derived from it may enjoy the stimulus of concerted action.

CROPS AND CULTIVATION

- AL 5 - Information Concerning the Amazon Region, Brazil. — LE COINTE, P., in *Revista*
 IV *Commercial, Industrial e Agrícola do Pará*, Year 10, No. 13, pp. 414-429, fig. 9. Belem
 (Pará), December 1920.

The immense basin of the Amazon, the typical region of *Hevea brasiliensis*, offers boundless sources of wealth to the planter and timber-merchant, but the adequate working of these vast forests depends upon two factors, a sufficient supply of labour and the skilled direction of experts in woodcraft. The colonisation of this territory is hindered by the climatic conditions, but their importance is often exaggerated. It must not be forgotten that the distribution of meteorological values differs considerably in the various sections of this vast region. Hence side by side with depopulated zones, where marsh fevers are rife, wide tracts of country are found which owing to the healthy climate are a pleasant dwelling-place even for the European settler.

The author gives an account of his study of the climate of the Amazon region, basing his remarks chiefly on data collected in the districts of Belem, Obidos and Manaos.

TEMPERATURE OF THE AIR. — The thermometric observations naturally give very different results according to the localities where they have been made. It is however noticeable that, generally speaking owing to the slope of the Amazon basin towards the Atlantic coast, the East and North winds find their way unhindered into and sweep right through the valley, and the great evaporation they produce on coming into contact with the damp forest growth, largely tends to prevent any excessive rise in temperature; on the lower Amazon, the average annual temperature is never above 28° C.

In the town of Belem (Pará), uninterrupted observations have been made at the Goeldi Museum for twelve and a half years; similar meteorological work was done in 1897 at the Secretariat of Public Works and at the Lauro Sodré Institute; the general average readings recorded (in centigrade degrees) were as follows: January, 25.9 — February, 25.3 — March, 25.9 — April, 25.9 — May, 26.1 — June, 26.3 — July, 26.4 — August, 26.3 — September, 26.6 — October, 26.8 — November, 26.8 — December, 26.4 — annual average 26.2.

The monthly means for 3 $\frac{1}{2}$ years of observations in the town of Obidos (Pará), on the Amazon, about 900 km. above Belem are as follows: January, 27.09. — February, 26.55 — March, 26.43 — April, 26.17 — May, 26.25 — June, 26.02 — July, 26.62 — August, 27.67 — September, 28.05 — October, 28.44 — November, 29.04 — December, 27.70 — annual average 27.17.

In the town of Manaos (Amazon) situated on the Rio Negro, a tributary of the Amazon 1574 km. above Belem, the thermometer readings are as follows: average annual temperature 26.8° C — maximum temperature (October 27, 1902) 37.5° C. — minimum temperature (April 28, 1902, 18.8° C — annual absolute deviation 18.7° C.

Thus, at any rate in the lower and middle valley, the weather is characterised by constant high temperatures with regular and slight variations. The variations, at Belem are in direct relation with the rainfall. In February which is the wettest month, the temperature is lowest, and November, the driest month, is also the hottest.

At Obidos and Manaos, the minimum temperature is registered in May-June, the thermometer falling through the influence of the "friagens", cold winds that rush down from the Andes. Here again however the greatest heat comes in November, the month of least rainfall.

As one leaves the river-banks and ascends the course of the tributaries, the heat decreases, and the difference between the day and the night temperature increases.

At 100 km. to the north of Obidos on the Ariramba plateaux, at an altitude of 280 m., the heat is already tempered by the drier air and strong ventilation from the north-east. Further north again on ascending terrace by terrace, the great amphitheatre that rises perpendicularly from the river, the traveller finds a temperate climate in Brazilian Guiana, which with its fine natural pastures would offer every advantage to the colonist, were it not that the waterfalls interrupting the course of its rivers, and the total lack of roads, render all access to the country very difficult.

The upper part of the basin of the southern tributaries (Jurna, Purus, Madeira), is swept at certain times of the year (from March to June) by intermittent violent winds (southwest) coming from the Cordilleras which are still covered with snow. These winds are known as "Sur", or "Friagem", and produce a sudden fall in the temperature. According to the author, on the Madidi, a tributary of the river Beni (Upper Madeira), in Bolivia, the thermometer drops in a few hours from 38° C to 11° C. Owing to the sudden lowering of the temperature, the atmosphere becomes saturated with moisture and a thick fog obscures the sun and extends over the district. The "Friagem" wind arises on calm hot days, shortly after the sun has passed the meridian, and is preceded by a fall of the barometer (5 to 6 mm.). The wind blows for 3 to 8 days.

The effects of the Friagem can be felt though to a very limited extent as far as Obidos and Manaos.

TEMPERATURE OF THE SOIL. — At Belem the soil temperature, at 1 metre below the surface, varies from 26° C. to 28.5° C. From observa-

tions made at the Lauro Sodré Institute (from 1904-1907), the annual average temperature is 27.45° C. At a depth of 30 cm. the average is 27.91° C.

RAINFALL AND FOGS. — The changes of temperature are not sufficiently marked to make it possible to divide the year into seasons. There are however two distinct periods, the rainy and the dry. The North-East Trade Winds passing over vast ocean tracts heated by the tropical sun, carry periodically into the basin of the Amazon enormous masses of water-vapour which ascend the valleys as far as the eastern ramparts of the Corderillas.

The sky is rarely clear, being usually greyish-blue and the horizon is veiled by thick fogs. The average nebulosity is 5.35 at Obidos, 6.3 at Manaus and 5.3 at Belem. In the latter town, it is 6.9 during the rainy season (January-April) and 3.6 during the dry (August to November).

At Belem, the so called dry period is only relatively dry for more or less rain falls throughout the year according to the seasons. The rains begin at the end of December, and attain their maximum from January to April; the winter, as the rainy season is called, finishes in August. The driest summer months are September, October and November.

All the country to the east of Gurupa, which includes the "furos" district, the great part of the "island" zone, the south and south east of Marajo and the right bank of the Pará as far as the coast, have the general climatic conditions of the Tocantin zone though slightly modified by the vicinity of the ocean.

From the observations made from 1894 to 1911, at the Museum, at Belem, the rainfall in that town is distributed as shown by Table I.

TABLE I. — *Rainfall Distribution at Belem from 1894 to 1911.*

January	296 mm	27 wet days
February	360 "	20 " "
March	388 "	28 " "
April	320 "	26 " "
May	261 "	24 " "
June	195 "	22 " "
July	166 "	19 " "
August	119 "	16 " "
September	87 "	16 " "
October	80 "	15 " "
November	64 "	13 " "
December	150 "	20 " "
Totals	2 486 mm.	252 wet days

The relative humidity of the air is always very high; the 10 years' average being: January, 92.3 — February, 93.08 — March, 92.5 — April, 91.5 — May, 89.1 — June 86.1 — July, 86.1 — August, 86.1 — September, 85.2 — October, 84.2 — November, 85 — December, 87.6 — Annual average 88.3.

TABLE II. — *Rainfall Distribution at Obidos.*

	Amount in mm.	Wet days	Relative humidity
January.	124.3	21.8	80.76
February.	173.2	20.2	81.25
March.	316.9	21.6	84.74
April.	225	23	85.34
May.	155.1	18.6	83.69
June.	93.8	12.6	79.33
July.	49.3	7	73.66
August.	14.4	4.5	69.26
September.	63	5.5	70.80
October.	67.5	5	65.00
November.	77	5.2	62.49
December.	113.3	12.7	78.77
<i>Totals</i>	1592.3	157.1	76.26

At Macapá on the northern bank of the estuary of the Amazon, the rainy season, which lasts for 8 months is clearly marked off from the dry season lasting for 4 months during which almost absolute drought prevails.

The same division of the year is met with on ascending the lower course of the great river, but the rainy season is reduced to 6 months and the amount of rainfall is correspondingly diminished. Table II gives the results of the observations made at Obidos during 4 $\frac{1}{2}$ years.

On the lower course of the Amazon, the North-east wind ("vento geral"), brings the dry weather and the west and the south-west wind ("vento de cima"), bring the rain.

At Manaus almost the same conditions are to be observed as at Obidos. The averages for five years are given in Table III.

Travelling from Manaus towards the interior of the basin the relative humidity is observed to increase, until the saturation point is reached, and condensation takes place owing to the countless streams, lakes and swamps that cover this region. At Porto Velho on the river Madeira, the rainfall already amounts to 2640 mm., distributed as follows: January, 373.8. — February, 338.8 — March, 330.2 — April, 255 — May, 139.2 — June, 52.8 — July, 17.8 — August, 34 — September, 142.2 — October, 240 — November, 328.1 — December, 386.8.

On ascending the course of the Purus, the climate becomes continually damper and the rainfall increases; the amount of water falling annually at Tefé is already double that falling at Obidos; at Pebas, the rainy season lasts nearly the whole year. From this point however the rainfall continues to diminish; at Iquitos (Peru), the average temperature is 48, the relative humidity 83, and the total rainfall 2840 mm.; August is the driest month. Finally Cordillera de los Andes, the Western boundary of the basin is reached; there the large masses of water vapour which pass up the great river valley from the Atlantic Ocean are condensed in the form of the rain that incessantly beats upon the eastern slopes of the mountain chain and the snows that cover its lofty summits. This condensation is so complete, that almost absolute dryness prevails on the other side of the crest on the Pacific slope.

Other Meteorological Phenomena. — In spite of the excessive humidity fogs are somewhat rare owing to the constantly high temperatures; they are however occasionally to be seen in the early morning in April and May. Little dew falls on the deforested land of the lower reaches of the river but heavy dews are common in the interior of the country. Violent hurricanes and sudden gusts of wind are of rare occurrence. The atmospheric pressure like the temperature is subject to slight and regular variations; it attains its maximum in the morning and diminishes progressively during the day.

TABLE III. — *Distribution of Rainfall at Manaus.*

	Amount in mm.	Wet days	Relative humidity
January	240	22.7	82
February	248	20	81
March	296	19.6	83
April	202	15.6	82
May	135	14.6	82
June	43	4	77
July	59	4.6	76
August	51	4.3	74
September	38	7	73
October	45	12.3	72
November	39	10.3	71
December	225	19.3	78
Totals	1 957	151.3	77.6

The degree to which the Amazon climate is healthy depends largely upon all the factors discussed above and varies considerably in different parts of the immense region. The climate is distinctly unhealthy in the interior, but continues to improve in the riverine zone of the middle and lower portion of the great river (r).

6 — Influence of Climate on the Fixity of Hybrids from the Standpoint of the Segregation of Characters in the Second Generation. — See No. 20 of this Review.

(1) On the other hand, the progressive draining of the interior (*sertão*) and systematic cultivation will gradually bring about the disappearance of the swamps and in consequence greatly increase the salubrity of the region. As Dr. Deodécio DE CAMPOS, Delegate of Brazil at the International Institute, has informed us, the district of Belem — in the low-lying district of the estuary of the Para — now enjoys a very healthy climate, owing to the drainage operations that have been carried out and to the energy of the special Sanitary Service (directed by Professor Osvaldo Cruz), which has completely freed the town from mosquitoes. (Ed.)

- 7 - **Researches on the Specific Gravity of Certain Soil Constituents from the Point of View of the Fineness of the Soil Particles.** — NOLTE, O. (Landwirtschaftliche Versuchsstation zu Braunschweig), in *Internationale Mitteilungen für Bodenkunde*, Vol. XI, Parts 3-4, pp. 117-118. Berlin, 1921.

SOIL PHYSICS

In theory it might be expected that the finer a body is, the less should be its specific gravity and this has again been proved by the author as regards certain typical soil constituents. He determined, with the help of a pycnometer, at 17-19° C, the specific gravity of fractions separated by mechanical analysis, estimating their density when air-dried at 100° C, and calcined, as compared with the specific gravity of water at 4° C. By this means as regards the precipitated silicic acid and kaolin, perceptible differences were found between the specific gravity of the fraction that was precipitated in less than 24 hours, and the fraction deposited subsequently; these differences showed themselves at the 2nd and even the 1st decimal place. On the other hand, in determining the chemical composition of fractions of a stiff clay deposited in 24 hours, and after this time had elapsed, it was found that not only some of the colloidal portion remained in suspension, but also that there were great differences in their composition; thus the silica fell from 56.45 to 53.2 and 53.1 %; the alumina rose from 37.26 to 40.9 and 42.0 %; and the sesquioxide of iron from 1.84 to 2.3 and 2.5 %; the amount of lime, magnesium, and sodium varied; on the other hand, the potassium content increased considerably, from 0.24 to 0.8 and 1.2 %; oxide of titanium was only present in the intermediate fraction. The variation of the specific gravity of the portions obtained by means of more fractional deposition is characteristic, as is seen from the following Table:

Specific Gravity	Fraction precipitated				
	Before 100 seconds	After 100 seconds	After 15 min.	After 2 hours	After 24 hours
Expressed in relation to air dried material	2.467	2.470	2.492	2.482	2.317
Expressed in relation to mat- erial dried at 100° C	2.626	2.615	2.640	2.638	2.497
Expressed in relation to calc- ined material	3.317	3.115	3.017	3.048	3.008

This shows, that there is a considerable difference between the finer particles and the coarser ones, which do not vary perceptibly.

- 8 - **Effect of Temperature Upon the Absorbent Properties of Soils.** — STOQUER, in *Comptes rendus de l'Académie des Sciences*, Vol. 173, No. 17, pp. 731-733. Paris, October 24, 1921.

Agricultural soils experience great variations of temperature. In the neighbourhood of Paris the difference between the monthly averages of the same soil in July and January has been found to amount to 24.4° C

at the surface and to 19.3°C at a depth of 0.25 m. (FLAMMARION). DR GASPARIN found a difference of 3°C at Orange.

The author wished to ascertain whether such variations had any effect upon the soil's power of fixing certain fertilising substances. He selected 4 soils differing in composition and studied their capability of absorbing sulphate of ammonium at 0°C , 16°C , 35°C and 55°C .

The experiment was carried out as follows: an amount of soil equivalent in weight to 100 gm. of dry soil was introduced into a flask, together with a total volume of 250 cc. of a very diluted solution of ammonium sulphate. The flask, which was kept in a bath at a constant temperature, was well shaken at the beginning and was afterwards shaken every 15 minutes for 1 hour. In order to clarify the solution, the flasks were left for 3 hours in the bath at the same temperature. A portion of the clear liquid was decanted and the ammonium present determined by distillation in the presence of magnesium. From the result obtained, the amount of ammonium fixed by the soil is estimated.

The total results are given in a Table from the study of which the following conclusions can be drawn:

1) The absorbent power always increased with the concentration of the solutions. This confirms an already well-known fact.

2) Under the conditions of the experiment, the absorbent power was sometimes negative (that is to say, the soil gave up some of the ammonium to the solution), or even sank to zero (when the solution contained the same amount of ammonia as the given soils). This occurred, within the limits of the temperatures studied, in the case of the first three soils with a 0.02/1000 solution, and in the fourth (garden mould), with a 0.08/1000 solution.

3) All the soils gave up ammonium to the distilled water (as was to be expected), and the amount yielded increased as the temperatures rose.

4) The absorbent power of the soil, as regards sulphate of ammonium decreased when the temperature was raised.

5) At temperatures that easily occur in soils, some are able to yield up their ammonium to 0.02/1000 and stronger solutions. These soils are not very poor in ammonium, and may have received a dressing of ammoniacal fertilisers. In certain circumstances, the amount of ammonium removed from the soil (without even being converted into nitrate), by the percolating rain-water is perhaps larger than is generally supposed.

The opinion is gradually gaining ground that soil solutions, in spite of their low content in fertilising substances, exercise a great influence upon plant nutrition. These solutions, as is seen from what has already been said, are richest in ammonium at the warmest periods, which is just when plant growth is most active; hence we may suppose that some correlation exists between the two phenomena.

9 - Relation between the Nitrogen Content of the Soil and the Yield of Indigo in India. -- See No. 50 of this Review.

10 - "Taungya" Cultivation in the Shan States, Burma, and Methods of Soil Treatment Recommended. — THOMPSTONE, E. (Deputy Director of Agriculture, Burma), in *The Agricultural Journal of India*, Vol. XVI, and Pt. 3, pp. 251-264, Pt. 4, p. 396-405. Calcutta, May-June 1921.

METHODS
OF
CULTIVATION

The "taungya" system of cultivation as practised in the Shan States, Burma, and elsewhere, has been the subject of official investigation for many years, chiefly on account of the enormous amount of damage done to forest areas and the heavy destructions of timber. The system includes the cutting down of the jungle growing on the hillside, lopping off any branches of the trees and heaping these up with the brushwood, etc. round the stumps and then firing the whole. This operation takes place during the dry weather (February to May). Subsequent cultivation depends upon the slope of the ground and often the use of a hoe is the only implement possible on the steep hillside.

After burning, the heaps are allowed to cool and if the crop grown is potatoes, the setts are planted in mounds from 1 to 3 setts in each; for other crops the heaps are spread by hand and the seed is sown broadcast. The principal crops grown in the Myelat are paddy and potatoes with an occasional crop of sesamum. Other crops grown are maize, ginger, ground-nuts, sweet potatoes, gourds, opium, cotton and several kinds of beans.

The land is cultivated from 1 to 3 years (rarely 4) and then allowed to lie fallow for a considerable period. The actual "taungya" process is varied somewhat according to locality, conditions of fuel supply, etc.

The cultivator often attributes the success of his "taungya" crop to the destruction by fire of insects and fungi, and his failure after 2 or 3 years, to the return of these pests. However, investigations have shown that the probable effect produced can be traced as follows: — The young crop first makes use of the ammonia directly produced by the heat and later of that produced by the increasing number of bacteria. This continues till the crop is harvested, after which the production of ammonia is lessened by its accumulation (which checks the activities of the bacteria) in the soil, and later by the drying of the soil which will eventually arrest the process and check the multiplication of both classes of micro-organisms for the period of the dry season. At the break of the second rains the soil bacteria still retain the upper hand, but before the season's crop has been harvested the destructive organisms are rapidly gaining ascendancy, and before the dry season again comes round, the increase is marked, at the expense of bacteria. Once the original state of equilibrium is fully established between the two classes of organisms, the effect of the burning will have disappeared and the soil will have returned to its previous natural state, which on account of its poverty in lime and organic matter will entail unprofitable crop production over very large areas.

The results of practical field experiments strongly support this theory, and the ultimate aim of all "taungya" investigations has been to bring and under permanent cultivation, to put a stop to this destructive method and thus to induce the people to settle down on holdings of reasonable size with consequent substantial benefit to the country.

There are obviously two ready substitutes for the heat (1) now being so laboriously applied, viz. lime and organic manures, small dressings of either have given more productive results and seem to be more lasting in their power than an ordinary "taungya" burning. The following examples demonstrate this fact:— The average increase in wheat yield on land to which lime was applied at the rate of 6000 lb. per acre, amounted to 273 lb. per acre (120 %) on land that had been cultivated for one year without previous burning, and an increase of 3440 lb. per acre of maize is reported on old "taungya" land. Corresponding results were obtained with *Phaseolus lunatus*, *P. calcaratus*, *Cajanus indicus*, *Cicer arietinum*, *Polygonum Fagopyrum*, etc.

As regards organic manure, in every case so far tried, the benefit derived from unburnt manure proved to be greater than that brought about by burning an equal quantity of manure. The following figures show also the advantage of planting potatoes in drills.

	Yield of tubers lb. per acre	Yield of grain lb. per acre
1919-20. In drills . . . Manure unburnt	9620	1200
" " " " Manure burnt . .	6960	900
" " " " No manure . . .	2800	nil
Hill method. . . Manure unburnt	4000	—
" " " " Manure burnt . .	3540	—

These results were obtained without the aid of lime, but a combination of lime and manure gave also very striking results. (Lime had been applied 2 years previously, 5000 lb. per acre).

	Yield of potato tubers lb. per acre	Yield of grain lb. per acre
Manure and lime	8780	1960
" (without lime)	6160	520

Some of the older plots that have so far received neither lime nor manure have however still maintained their yields by good cultivation and rotations, and leguminous crops have been grown with success.

The author considers that liming, manuring and good cultivation, combined with a proper system of rotation can make continuous cultivation

(1) See R. Jan. 1913, No. 14, and R. June 1913, No. 646. (Ed.)

much more profitable than the present methods of shifting from place to place. The natural advantages for agriculture and the evident future possibilities for the Shan States make the need for experimentation extremely important.

Experiments in Liming in the United States and in Canada. — I. HARTWELL, B. L., **Liming with High-Magnesium Versus High-Calcium Limes**, in *Agricultural Experiment Station of the Rhodes Island State College, Bulletin 186*, pp. 19, Kingston, R. I., May 1921. — II. McCALL, A. G., **The Comparative Value of Different Forms of Lime**, in *The University of Maryland Agricultural Experiment Station Bulletin 242*, pp. 157-166, College Park, M. D., January 1921. — III. SMITH F. S. (Dominion Chemist), **Lime in Agriculture**, in *Dominion of Canada, Department of Agriculture, Dominion Experimental Farms, Division of Chemistry, Bulletin 80*, pp. 16, revised, Ottawa, Ont., May 1921.

MANURES
AND
MANURING

I. — Experiments to determine the liming effects of high calcium and high magnesium limestones, as well as of their burned and hydrated products.

The tests were carried out on permanent experiment plots of silt loam which were ploughed in 1893, and cropped with maize until 1899, after which various crops were grown till 1909, when the present experiments were begun. No lime, manure or fertiliser had been previously used. The first application of lime was made in 1909-1910, the amount used being sufficient to neutralise the same quantity of acid. The second and third applications of lime were made in 1914 and 1916. The latter completed the neutralisation of the soil acidity when, judging from the influence of the carbonated water, the speed of reaction of the limes would decrease in the following order: Magnesian hydrate, calcic hydrate, calcic limestone, magnesian limestone. From 1909 to 1921, the crops were mixed; hay, maize, potatoes, etc. No farm manures were used, but chemical fertilisers were usually applied so liberally that the liming materials were expected to act as neutralisers only and not as sources of plant food.

Beginning in 1917 the proportion of magnesium to calcium was increased by using in the mixture low-grade sulphate of potash and double superphosphate.

In 1920 the ratio of magnesium oxide to calcium oxide extracted from the soil by carbonated water was about $\frac{1}{7}$ from the plots receiving the calcic limes; $\frac{1}{1.7}$ from those receiving the magnesian limes, and $\frac{1}{2.2}$ from the unlimed plot. The yields were equally satisfactory whether the ratio was $\frac{1}{7}$ or $\frac{1}{1.7}$. In 1917 the ratio of magnesium oxide to calcium oxide in dried endive was respectively $\frac{1}{1.1}$ to $\frac{1}{1.5}$ with the plots that had received magnesian hydrate and limestone; from $\frac{1}{2.2}$ to $\frac{1}{3}$ in the case of the plots given calcic hydrate and limestone, and $\frac{1}{2.8}$ in the control plot without lime.

The humus content and loss on ignition indicate slightly less organic matter in the soil to which the hydrates instead of the limestones had been added. It can scarcely be concluded with certainty that the different limes have been accompanied by a change in the nitrogen content of the limed soil as compared with that of the unlimed soil, although the percentage of nitrogen is slightly higher where magnesian limestone was used. The unlimed plot was decidedly acid as compared with the limed plots, but it was the only one from which aluminium was extractable by certain normal salt solutions, and by carbonated water.

Certain sensitive crops have been greatly benefited by the liming; the beet yield for instance was frequently increased sixfold. Even these crops did not however react to the liming in such a way as to warrant generalisations concerning the specific effects of the different kinds of lime. Practically like effects may be generally expected whichever of the four forms is used, from an application having a given neutralising equivalent, that is, based upon the percentage of magnesium oxide multiplied by 1.4, plus the percentage of calcium oxide, provided that the limestones are sufficiently fine to pass through an 80-mesh sieve, and that the hydrates are used with the ordinary precautions.

II. — Lime is the key to soil fertility building, since the economic use of both manure and commercial fertilisers is dependent upon the lime supply of the soil.

The author tested the value of several lime-bearing materials in 3 different parts of the State. In one case, he compared the effect of : 1) burnt lime ; 2) burnt oyster-shell ; 3) shell marl ; 4) pulverised raw shell. The shell marl gave the highest yield of wheat and hay while the pulverised shell produced almost as much wheat and hay and a larger amount of maize. It should be mentioned that the marl contained nearly 3 % of potash which may account for its superiority.

In another experiment, a comparison was made between the effects of pulverised raw oyster shell, burnt oyster shell, pulverised raw limestone and burnt limestone ; the total average increase on the two plots during seven years as compared with the control plot, expressed in dollars per acre was 78.43 for the pulverised oyster shell, 73.85 for the burnt oyster-shell, 77.60 for the pulverised raw limestone, and 77.05 for the burnt limestone ; thus the differences between the effects of the various forms of lime used are negligible. In another experiment with lucerne, it was found, that raw pulverised limestone gave better results than raw oyster-shell lime, burnt limestone and hydrated lime.

In conclusion, the author advises agriculturists to determine whether their soils need lime and the amount required.

III. — The practice of liming has been sometimes encouraged and at other times discontinued, which shows that if lime must be used it should be applied in moderation. The author described the experiments made of recent years by the Chemical Division of the Organisation of the Experiment Farms of East Canada. These have proved that in many

laces, the yield has been increased by liming, especially in the case of clovers which form the basis of profitable agriculture.

In one experiment on clayey-sand the application of 672 kg. of potassic fertiliser per hectare which supplied 22.4 kg. of nitrogen, 44.8 of phosphoric acid, and 56 kg. of potash, and was spread before oats were planted, produced in 1914, 51.57 hectolitres of grain per hectare. Another plot treated in the same manner, but to which 2240 kg. of ground limestone was applied, produced 59.58 hectolitres per hectare (or 8 hectolitres more than the first lot). The second year of the rotation, the unlimed plot bore 55.5 quintals of clover and timothy-grass hay, whereas the limed plot yielded 3.8 quintals or 28.3 quintals more.

In another experiment two series of parallel plots on soil similar to the preceding, were dressed at the beginning of each rotation in the autumn with 50.2 quintals of ground limestone, and in the following spring each of the series was given a different manure. In 1919, two three-year rotations of potatoes, cereals and clover gave the final results set forth in the following Table.

Leaving out of account the evident effect of the dung, these data show that the lime stimulated the action of the fertilisers and their residues in each three-year rotation. The effect of ground limestone is especially noticeable in the case of grasses particularly where basic slag was applied.

Average Yield per Hectare.

1st Rotation (1914-16)	Potatoes 1914 hectolitres	Oats 1915		
		Grain	Straw	Hay 1916
		hectolitres	quintals	quintals
Control	50.31	27.36	18.1	8.06
Limestone alone	69.84	29.52	18.7	12.43
Chemical fertilisers alone . .	76.02	28.53	20.4	7.39
Fertilisers and limestone . .	86.04	34.56	24.6	16.73
IInd Rotation (1917-19)	Potatoes 1917 hectolitres	Wheat 1918		
		Grain	Straw	Hay 1919
		hectolitres	quintals	quintals
Dung alone	226.62	17.55	22.2	29.57
Dung and limestone	282.06	26.82	25.3	45.81
Dung and chemical fertiliser .	263.16	20.93	22.4	35.01
Dung, fertiliser and limestone	296.37	27.18	29.4	55.17

In an experiment on sandy soil, where a comparison was made between unlimed plots and others to which 5 tons of limestone per hectare had been applied, the average yield of seed per hectare was for 3 varieties of barley 10.58 and 43.68 respectively — for 5 varieties of oats, 100.12 and 113.57 — for 4 varieties of wheat, 36.12 and 46.04 — for 4 varieties of peas, 39.14 and 79.30.

In Canada, some of the commonest calcareous substances are marl,

or shell-marl, with a lime content varying from 30 to 90 %. The author advises the application of from 5 to 12.5 tons of dry marl for light and clay-sandy soils, and of 25 to 75 tons for heavy clays. The land should be ploughed and harrowed both in the spring and autumn. If marl is to be obtained, there is no need to get ground limestone or lime, for marl is cheap, improves the soil greatly and increases the yield.

This Bulletin concludes with a series of analyses of the calcareous substances suitable for agricultural use that are to be procured in the different provinces of Canada.

12 - **The Present Condition of the Superphosphate Industry in Japan.** — ISHIKAWA I., in *Kōgyō-Kumogata Zasshi* Vol. XXIV, No. 7, pp. 700-717, figs. 5. Tokyo, July 1927.

In Japan, the greater part of the people are engaged in farming, and the capital invested in agriculture is three or four times higher than in the manufacturing industries. The area of land cultivated for 2 000 years is as follows :

Rice-fields	3 010 000 <i>chobu</i>
Under other crops	3 070 000 "
1 <i>chobu</i> = about 2.45 acres).	

The rate of increase in population amounts annually to 1.0 per cent. while that of rice-fields, and other fields under cultivation is only 0.4 per cent. in each case. Therefore, if Japan does not make efforts to intensify production by using chemical fertilizers, the food problem will become serious.

The fertilizers used are bean cake, rape cake, cotton-seed cake, pressed herring, pressed sardine, bone meal, Chili nitrate, ammonia sulphate, superphosphate and mixed fertilizers. In 1919, the total cost of these fertilizers (with the exception of Chili nitrate) was estimated at 240 000 000 *yen* (1 *yen* = about 2 shillings at par), of which 10 % was superphosphate and 60 % bean cake.

The present condition of the superphosphate manufacturing industry is as follows :

Number of companies	15
Number of factories	28
Productive capacity	25 000 000 <i>yen</i>
Nominal capital	72 000 000 "
Capital paid	53 000 000 "
Current capital	111 000 000 "
Permanent investment account	28 000 000 "

The number of sulphuric acid plants, which are closely connected with the superphosphate industry, is 53 and most of them are in the Tokio and Osaka districts.

In 1888 the first artificial fertilizer company in Japan was established. Since the China-Japanese and Russo-Japanese wars, as a result of the prosperous conditions of the market, new companies were established. When trade became dull, amalgamation took place, so that the present companies rest on a stable basis and are reliable.

The demand for mineral phosphate is 300 000 tons yearly, while the home production is chiefly from Rasa Island ; but its maximum production amounting to 110 000 tons per annum only, Japan must continue to import the raw material. Angaur Island has lately come into the possession of Japan and it will somewhat neutralize this disadvantage ; its reserve, however, is said to be only 2 000 000 or 3 000 000 tons. Probably more mineral phosphate will be supplied from the province of Kiangsu (China), and from Hirata Island, south of Hainan Island.

As to sulphuric acid, there are 124 lead chamber and tower system plants and 8 plants employing the contact process. The total capacity of production is estimated at 1 150 000 tons of 50° Bé. acid per annum, the actual amount being 900 000—950 000 tons, 500 000—550 000 tons of which are used to produce superphosphate.

In Japan, superphosphate is mainly packed in straw bags, even though a small amount of burlap bags is used. The straw bags are mostly made by hand as farmers' by-products and the old bags are re-used by them for many purposes. Therefore packing by machine is not, for the time being, considered desirable. The present production of superphosphate amounts to 15 000 000 bags (1 bag contains about 83.3 lbs.) per annum, and if the time comes when more superphosphate is used for every area unit, *e. g.*, 10 bags per 1 chobu, 30 000 000 bags will be required in Japan. Moreover, China is thickly populated and does not at present use any artificial fertilizer (1). When it does come into use in China large quantities can be applied from Japan. Consequently there are limitless prospects for the superphosphate industry in Japan.

3 - **Relation of Organic Matter and the Feeding Power of Plants to the Utilisation of Rock Phosphate.** — BAUER, F. C., (Agricultural Experiment Station, University of Wisconsin), in *Soil Science*, Vol. XII, No. 1, pp. 21-39, tables 9, bibliography of 15 works. Baltimore, M. D., July 1921.

The processes accompanying the decomposition and the feeding power of plants are undoubtedly important factors in the utilisation of rock phosphate. Experiments were planned in which common forms of organic matter were used with rock phosphate and in some cases provision was made for the removal of the soluble phosphorus and calcium in order more nearly to imitate field conditions in this respect. The soil medium consisted of either sand or soil, the former contained no soluble phosphorus. Experiments were made as follows : a) rock phosphate mixed with several forms of organic matter in sandy soil with no provision for the removal of phosphorus as it became soluble ; b) in similar mixtures provision was made by leaching and c) by upward moving capillary water, both for the removal of phosphorus as it became soluble ; d) study of the solvent effect of organic matter extracts with and without carbon dioxide on rock phosphate ; e) pot culture experiments, also made to ascertain this effect and to test the feeding powers of plants in relation to the utilisation of rock phosphate and felspar. The results may be summarised as follows :—

(1) See K. Sept. 1920, No. 889, (Ed.)

1) Experiments (a) (b) (c) and (d) failed to show a solvent effect of the decaying matter on rock phosphate, and in confirmation of results obtained by other investigators there was evidently a gradual decrease in the amount of soluble phosphate. The failure of the experiments to show an increase in the availability of rock phosphate was probably due to the fact that when organic matter such as was used (in this case, finely pulverised air dry buckwheat hay, sweet clover hay, alfalfa hay, soybean hay, mammoth clover hay, maize stalks, oat straw and chopped green buckwheat and sweet clover) decomposes, sufficient bases are liberated along with the acids that are formed, to neutralise the acids and prevent their action on rock phosphate. When mixtures of rock phosphate and organic matter are applied to soils, the conditions are different because of the capacity of soils to take up basic material, especially if they are acid.

In some cases mixtures of organic matter and rock phosphate applied in pot cultures produced increase in growth of maize over that produced by either the organic matter or rock phosphate when used alone. The phosphorus in the organic matter was readily available to growing maize. The organic matter furnished phosphorus to the seedling and thereby promoted growth which may have enabled the plant to feed more strongly on the rock phosphate or the rock phosphate may have been made more available by the chemical and biological processes accompanying the decay of the organic matter.

A study of the growth of 15 different plants on rock phosphate in sand cultures showed a wide variation in the amount of dry matter produced. The crops tested were red clover, sweet clover, wheat, oats, maize, timothy, soy beans, rape, alfalfa, rye, buckwheat, red top, red sorrel, mammoth clover and alsike clover. Tables show the average yields of dry-matter of the tops, roots and plants as a whole, the proportion of roots to the whole plant when grown with rock phosphate, and the percentage growth made with rock phosphate compared with that made with acid phosphate are recorded; also the phosphorus and calcium content of plant tops and acidity of leaves, stems, and roots of plants grown with acid cultures with no potash, soluble potash and felspar potash.

Results show that there was quite a wide variation in the growth of the different plants with rock phosphate used at the rate commonly advised for field practice. Sweet clover and red sorrel produced the largest proportionate increases of dry matter and red clover the smallest. The increases of the former were about $3\frac{1}{2}$ times greater than the latter. Sweet clover possesses remarkable feeding powers relative to rock phosphate and felspar and is well suited to rotations for their utilisation. With the exception of sweet clover which gave a slight increase, all the plants analysed showed somewhat distinct decreases in the percentage content of phosphorus when grown on rock phosphate as compared with acid phosphate. In general, neither the percentage content, nor the total amount of phosphorus in the plant tops was related to the amount of plant growth made with rock phosphate.

The acidity values of the juice of the leaves, stems and roots varied considerably with the different plants. In general the juices were more acid when grown with acid phosphate than with rock phosphate.

The possibility of growing crops of high feeding power to supply organic matter and available phosphorus in rotation with crops of low feeding power is a question of considerable practical importance in the utilisation of rock phosphate.

- 14 - **The Effect of Basic Slag upon Grassland and the Subsequent Crops.** — OLDERSHAW, A. W. (Agricultural Organiser for East Suffolk), in the *Journal of Agricultural Science*, Vol. XI, Pt. 3, pp. 288-292. Cambridge, July 1921.

Two plots of grassland, each $1\frac{3}{4}$ acres in extent, on a poor type of chalky boulder clay, were fenced off with wire netting; one was reserved for control purposes, and the other received a dressing of 10 cwt. per acre of basic slag, and a second dressing of a similar nature 8 years later. After 12 years of regular sheep grazing, on analysis of the first and second 3 inches of soil, the basic slag plot was found to contain 500 lb. of nitrogen per acre more than the unmanured plot.

The following year the plots were mown, ploughed up, and drained and sown with legumes and wheat successively, with dressings of superphosphate and sulphate of ammonia. The turf on the "slag" plot was very thick, and the yield was fairly high probably due to the thick growth of wild white clover. The increase in nitrogen as compared with the unmanured plot is only about 10% whilst the increase in crop is much larger. It appears likely that the nitrogen assimilated being of more recent origin, would be more easily available to plants than the original nitrogen reserves of the soil. It is likely also that the extra plant residues left on the slagged plot, have a considerable influence on the mechanical condition of the soil and on its humus content. It is well-known that the presence of phosphate in heavy soil causes increased root development, but whether this applies also to slagged plots and the actual fate of the phosphates in this case, are points which still require investigation.

- 15 - **Results of Manuring with Superphosphate on the Yield and Quality of Indigo in India.** — See No. 50, of this Review.

- 16 - **Effect of Phosphate Fertilisers in Conjunction with Green Manures, upon Spring Cereals in India.** — See No. 50 of this Review.

- 17 - **Availability of Organic Nitrogenous Compounds.** — ROBINSON, C. S., WINTER, O. B., and MILLER, E. J. (Michigan Agricultural Experiment Station, East Lansing, Michigan), in *The Journal of Industrial and Engineering Chemistry*, Vol. XIII, No. 10, pp. 933-936, diagr. 1, New York, Oct. 1, 1921.

Several years ago investigations were started with the following objects:

- a) to ascertain the relation between the chemical constitution of organic nitrogenous substances and the availability of their nitrogen for plant nutrition; b) either to devise a new method or to improve the existing methods for measuring this availability. Both these questions are of importance because of the growing tendency to utilise all sorts of organic nitrogenous substances as fertilisers.

Amongst the various methods put forward for the determination of the availability of nitrogen as regards the said substances, two only, both of them developed rather empirically, have shown themselves of comparative value; viz. the alkaline permanganate and the neutral methods. In the present investigation the authors made determinations, employing the alkaline permanganate treatment, of the active insoluble nitrogen in a number of amino-acids and acid amides, typical organic compounds of known constitution in which the nitrogen was combined in several ways. After this, further investigations were made in a similar way, on the well-known proteins or substances containing them. Finally analyses were made of samples of commercial nitrogenous fertilisers employing the same method and the nitrogen partition method of VAN SLYKE. Data relative to these determinations are given as follows:

Per cent of Total Nitrogen of Fertilisers in Various Forms.

	Total nitrogen	Soluble nitrogen (ammoniacal and nitric) + active insoluble	Amide nitrogen	Amino nitrogen	Amide + amino nitrogen
Peat (dried)	2.76 %	40.21 %	20.65 %	39.14 %	59.79 %
Peat (wet)	3.49	42.40	13.46	39.53	52.99
Pulverised sheep manure	2.34	28.20	14.53	41.88	56.41
Hay and silage	3.10	16.71	6.13	42.22	48.35
Fruit and vegetables	3.74	43.85	5.09	49.20	54.29
Bone meal	2.18	40.43	4.84	49.20	54.04
Animal tankage	4.40	56.94	7.95	54.31	62.26
Pure bone meal	3.12	62.81	8.61	55.76	63.77
Castor bean cake	4.78	48.96	11.09	55.85	66.94
Cotton seed meal	6.73	50.51	10.33	58.00	68.42
Bone	3.05	67.21	5.24	60.98	66.22
Glue hair	8.49	64.55	5.89	66.77	72.66
Beef scraps	8.72	74.54	5.96	68.11	74.07
Hair waste	14.27	70.85	9.52	70.00	79.52
Dried blood	14.01	71.31	6.56	75.23	81.79
Mixed chrome uppers	9.88	51.22	4.76	60.32	65.08

Assuming that the ammonifying as distinguished from the aminifying or hydrolysing power of the alkaline permanganate solution is comparable with the action of soil agents, all amino nitrogen and a portion of the nitrogen present as acid amides may be said to be included. There is also another class of compounds termed the potentially available class, which may be converted into the former class. This includes a portion of the acid amides, the peptides which can be hydrolysed to amino acids, and primary and secondary amides. The peptides probably constitute the great bulk of this class so far as ordinary fertiliser materials are concerned. This is the uncertain quantity in evaluating any material from the fertiliser standpoint. In some cases transformation into the available class is

so easy and complete that there can be no practical distinction between the two. In other cases however this process is so slow that the unavailable class is approached. Fundamentally, the problem of the determination of the availability of organic nitrogen compounds is the possibility of a proper estimation of the rate of ammonification of the members of this class. Up to the present the permanganate methods have proved the most satisfactory and the authors will publish later the results of their further studies.

18 - **The Influence of Certain Fertiliser Salts on the Growth and Nitrogen Content of Some Legumes.** — MAC TAGGART, A. (Cornell University), in *Soil Science*, Vol. XI, No. 6, pp. 435-454, figs. 2, bibliography of 61 works. Baltimore, M. D., June 1921.

It has been fully demonstrated that calcium plays an important part in the soil in the symbiotic assimilation of nitrogen by legumes, but the activity of certain other fertilising elements has not been so fully shown. For this reason the author after a bibliographical survey of the literature on this subject, gives the results of a series of experiments made with 36 boxes filled with a soil mixture consisting largely of clean sand and about $\frac{1}{4}$ of sandy loam with slightly more than 0.5 % of calcium carbonate added to each box. The moisture content of the soil was maintained throughout at 10 % (on the dry-soil basis). Half of the boxes were filled with alfalfa and half with peas. The boxes were divided into 9 series of 4 and treated as follows: 1) control; 2) nitrogen (dried blood); 3) phosphorus (disodium phosphate); 4) potassium (muriate of potash); 5) sulphur (gypsum); 6) nitrogen, phosphorus, potash and sulphur in above forms; 7) nitrogen, phosphorus, and potash *idem*; 8) nitrogen, potash and sulphur; *idem*; 9) phosphorus, potash and sulphur, *idem*. Previous to sowing, all the boxes were inoculated with sand cultures. Following the crop of field peas, soy beans were sown, after suitable inoculation of the soil, application of calcium carbonate and fertiliser.

Of all the fertiliser elements applied, the phosphorus showed the most marked effect. Alone, it distinctly increased the dry matter and total nitrogen, and to a lesser extent the percentage of nitrogen in all 3 legumes; the order of average influence on the crop being: field peas, soybeans and alfalfa.

In combination with nitrogen, potassium, and sulphur, phosphorus markedly increased the dry matter and total nitrogen in peas, soybeans and alfalfa. However, it increased on the contrary the percentage of nitrogen in soybeans and alfalfa only slightly, and decreased the percentage in the case of peas.

Nitrogen as a single element can hardly be said to benefit the plants with respect to yields of either dry matter or nitrogen, except perhaps in the case of field peas. In combination with phosphorus, potassium and sulphur, nitrogen did not produce any lasting effect where it was employed alone; in fact, there was perhaps less response. It may be concluded also that nitrogen in combined form does not hinder nitrogen assimilation by legumes. Potassium used alone caused an increase in the total nitro-

gen and dry matter in field peas and alfalfa in the order named, but a decrease with respect to these factors in soybeans. Only in the percentage of nitrogen did potassium show an increase common to all 3 crops, in the order named above. Sulphur in the form of gypsum used alone or with other fertilisers somewhat increased the growth and nitrogen content of alfalfa, but does not appear to have had any effect on field peas and soybeans.

Taking into consideration the influence of the fertilisers employed for nitrification purposes or rather to assist in the nitrogen accumulation in the soil, the most marked effect generally was produced when phosphorus was applied, which resulted in the distinct development of the crops. Nitrogen applied alone increased soil nitrification after the harvesting of all three crops, particularly after alfalfa, but when applied in combination with other fertilising substances, it did not have this effect. Potassium, in the form of muriate of potash, apparently slightly inhibited nitrate-nitrogen accumulation; the sulphur, in the form of gypsum, increased nitrification subsequently in the soil. In general, there appeared to be a tendency toward correlation between the dry matter produced and the subsequent soil nitrification, due probably partly to the greater root system associated with increase in top growth, and hence to greater amounts of decayed roots, favourable to nitrification.

19 - **Carbonication of Plants By Combustion Gases.** — RIEDEL, F., in *Chemiker Zeitung*, Year XLV, No. 101, pp. 829-830. Cöthen, August 30, 1921.

After having disposed of the various objections raised in connection with the practical installation of plant for the carbonisation of crops in the open field by means of combustion gases, especially those from siderurgical works (1) the author gives figures showing the economic returns from the process. He calculates that for the carbonication of one hectare of land, 500 m. of cement pipes with a diameter of 10 cm. are required; the distance between the pipes being 25 m. The price of the pipes in March 1921, was 7.5 marks per metre; counting transport and laying, the cost would work out at 12 marks the metre which would make 6000 marks per hectare; by adding a similar sum for the cost of the chief gas pipe and various expenses, the total amount would be 12 000 marks per hectare or 1.2 marks per sq. metre.

Calculating the working expenses per square metre the following figures are obtained;

	Marks
20 % depreciation and interest	0.21
Cost of extra mineral fertiliser required.	0.12
Repairs	0.08
Cost of extra labour necessitated by heavier crop	0.10
Marks	0.51

(1) See R. June 1920, No. 626. (*Id.*)

If as a result of the carbonication, the potato crop is doubled; that is to say if it rises from 1.75 kg. to 3.50 kg., the net profit in the case of potatoes fetching 0.60 marks the kg., will amount to 0.51 marks per square metre or 42 %, and if early potatoes are grown, the profit is even higher. The prices quoted above are for installations that can use the discharge of gas motors which finds its way to the soil of its own accord; should ventilators for the expulsion of the gas be needed, this would mean an extra expense of some pfennige, but in any case there would be a good margin of profit.

As regards the larger water requirements of crops subjected to carbonication the author states, that the greater development in length of the plants' root systems enables them to make better use of the reserves of water in the soil. It may however be the case that in years of drought the full-benefit of carbonication can only be obtained by the application of carbon dioxide.

- 20 - **A Systematic Catalogue of the Plants Cultivated in Spain (Species and Varieties) and of the Principal Species of Trees.** - DANTÍN CERECEDA J., *Catálogo metódico de las plantas cultivadas (especies y variedades) en España y de las principales especies arbóreas*; Servicio de publicaciones agrícolas de Ministerio de Fomento, pp. 62, figs. 22. Madrid, 1920.

With this work of enumeration and identification which extends as far as possible even to varieties, the author begins his phytographical study of the plants cultivated in Spain. He does not pretend to have made a complete list, although many of the popular names he gives are recorded for the first time. In this catalogue, there are 422 species with their botanical names and the popular names by which they are known in the different Provinces of Spain. Then follows a table of 1000 popular names, and a bibliography of the 13 works most frequently consulted.

AGRICULTURAL
BOTANY,
CHEMISTRY
AND
PHYSIOLOGY
OF PLANTS

- 21 - **"Arroz brabo", Wild Rice in the Interior of Brazil.** - A Lavoura, year XXV, Nos. 8-9, pp. 219. Rio de Janeiro, September 1921.

In the State of Goyaz and in the inundation zone of the Araguaya, there are large quantities of a wild cereal much resembling rice, and known in the country by the name of "arroz brabo" (wild rice).

This plant only differs from common rice in having looser panicles and more brittle seeds.

In the neighbourhood of the river Jaoahé, "Arroz brabo" is used with much success in fattening stock.

- 22 - **Composition of Californian Citrus Fruits.** - CRIVER, E. M., (Chemist in Charge), WILSON, C. S. and CHURCH, C. G. (Assistant Chemists, Laboratory of Fruit and Vegetable Chemistry), in *United States Department of Agriculture, Bulletin No. 933. Contribution from the Bureau of Chemistry*, pp. 1-48, figs. 4, bibliography of 5 works. Washington, Oct. 15, 1921.

From 1887, when 12 cartloads of citrus fruits were exported from California, until 1919-20, when 12 000 were exported, the cultivation of Californian fruits has been very widely extended. The varieties grown to the largest extent at present owing to their suitability to Californian conditions, are "Eureka", native of California raised from Si-

cilian citrons, and the "Lisbona", widely spread and imported directly from Australia. The authors have analysed the fruits of these two varieties and also of a third, viz. "Villa Franca", at the present time not grown. It is considered advisable that the grower should be kept acquainted with the data relative to the composition of the fruits no less than the manufacturing establishments directly connected with the products, such as oils and citric acid.

The results obtained indicate the comparatively negligible differences existing between the various characters of the varieties studied. The most outstanding are those with reference to the specific weight of the fruits; the Eureka seems to stand at the top and the two others were practically identical. As regards the essential oil content, the var. "Villa Franca" showed the highest percentage, whilst "Eureka" gave a somewhat lower percentage. Although no difference was noticed in the citric acid content, there was a marked difference in the sugar percentage between the Eureka and "Lisbona" varieties.

Acidity attains its maximum at the beginning of autumn; the maximum specific weight is reached towards midsummer, and the minimum during winter. The minimum essential oil content was found to be at the end of winter and in the spring, and the maximum in the autumn.

No correlation was observed between the colour of the bark, its thickness and the composition of the fruits, but the specific weight and the acid content became less with the thickening of the bark. No difference was observed between fruits obtained on the sea coast and those from inland.

23 - **A Study of Nitrogen and Root Space as Factors Limiting the Yield of Maize in Egypt.** — PRESCOTT, J. A., in *Sultanic Agricultural Society, Technical Section, Bulletin* No. 4, pp. 1-14, figs. 6. Cairo, 1920.

The response of the maize crop to nitrate of soda has been shown as the result of field experiments conducted by the Sultanic Agricultural Society at Bahtim, to follow very closely the mathematical expression of MITSCHERLICH relating to the Law of the Limiting Factor (*Landw. Jahrb.* XXXVIII, 1909, p. 537; *Landw. Versuchs. Stat.*, LXXV, 1911, p. 231; LXXVIII, 1912, p. 127).

The dressing of nitrate of soda usually recommended in Egyptian farming is 150 kg. per feddan (1 feddan = 1.038 acre), but 200 kg. is frequently employed as a standard of comparison. In this experiment it was found that up to 300 kg. there was a steady increase in yield of crop, but if 400 kg. was applied, there was a smaller yield. Whether this diminution is due to the harmful effects of excess of nitrogen or of excess of sodium salts remains yet to be ascertained and the author proposes the repetition of the experiment, using ammonium nitrate instead of sodium nitrate.

It is frequently the case that the use of large quantities of nitrogenous manures retards the maturation of the crop; in the Bahtim experiments, however, no retardation has been observed.

The author includes data relative to harvest, effect of increasing dressing of sodium nitrate, etc.

Root Space as the Limiting Factor. — The spacings adopted varied from 25 cm. up to 95 cm. The original plots were each $\frac{1}{10}$ feddan and were subsequently divided into two parts, the northern half receiving nitrate of soda at the rate of 150 kg. per feddan and the southern half being left unmanured :

In both the manured and unmanured series the mathematical expression of MITSCHERLICH can be applied with fair agreement.

The yield per feddan, according to the given curves, can be related to the number of plants per feddan, giving a maximum yield at the spacing of about 16 000 plants per feddan (nitrate series) and of 10 000 plants per feddan (unmanured series). It is significant that the local method of planting gives an intensity of about 12 000. However, within fairly wide limits, the yield does not appear to vary very much and it seems probable that the maximum crop would be between 12 000 and 20 000 in the nitrate series and between 8 000 and 14 000 in the unmanured series.

During the growth of the plant, weekly observations were made on the heights of the unmanured plants, the measurements being made to the tip of the longest leaf and later to the end of the tassel; curves are here given for the recorded heights. The plants in all the spacings grew together for the first 15 days after which there was a successive breaking away; it is thus possible to trace the course of the lateral root development and interference during the course of the season. The following data indicate this development during the growth period (diameter in cm.) for 5 successive fortnightly periods, viz. 25, 35, 45, 65, 85.

The author includes data relative to harvest as a result of sodium nitrate treatment and also for the spacing experiments, and curves, etc. showing the effects produced in every case.

4 - *Observations on the Growth of Maize in Egypt.* — PRESCOTT, J. A., in *Sultanic Agricultural Society, Technical Section, Bulletin* No. 7, pp. 1-25, figs. 10, tables 11, Cairo, 1921.

During the seasons 1918 and 1919 observations were made in 3 different ways on the growth of maize.

I. *AUTOMATIC RECORDS OF GROWTH RATE.* — The curves given indicate that there are two maxima during the 24 hours; at no time does the maize plant stop growing altogether but at daybreak there is usually a slight decrease in the height probably associated with the opening of the stomata and the loss of water due to the resumption of day time transpiration. This is followed by a rapidly increasing rate of growth until the latter part of the day is reached when a slight retardation is observed; in the late afternoon there is again an acceleration giving a new maximum about sunset. During the night the growth rate falls off gradually to the minimum just before sunrise. A retardation of growth rate due to the soil water factor is shown in all the curves though only to a slight extent. Measurements made in 1918 by MOSSÉRI in his garden at Giza show the growth of plants during 12-hour periods of day and night, and it appears that growth in the night hours from 8 p. m. to 8 a. m. tends to

be greater than in the day time 12 hours period, doubtless owing to the check during the hotter part of the day.

II. DAILY MEASUREMENTS OF GROWTH RATE ON SELECTED MAIZE PLANTS. — The temperature and humidity records were taken from the mean data for Abbassia and Giza supplied by the Physical Service of the Ministry of Public Works. The curves for the 3 day means are given. The main features brought out are in the first place the effect of irrigation on growth (after each watering there is a marked increase in growth rate); this is shown particularly well in the 1919 curves where the soil moistures are given. There is also a fairly close relationship between the temperature and growth rate in the early part of the season, when soil moisture is abundant. This relationship becomes less noticeable as the plant becomes more developed and the soil moisture conditions intervene.

In 1919, an experiment was planned in which soil moisture determinations were made every 2 or 3 days so that as soon as the water content (depth 20 to 40 cm.) approached 25 % of the dry soil, irrigation was possible. It was found necessary to irrigate more frequently than usual and a slight benefit was obtained in the final yield. Later experiments indicated that with heavy manuring the effect of the water factor on the yield became more marked. The adjoining table indicates that frequent irrigation as controlled by soil moisture gave a yield (stalks and ears respectively) of 4760 kg. and 1510 kg. per feddan, and the yield with normal irrigation (7 times between July 7 and October 22) of 4630 kg., and 1460 kg. There was also an increase in the heights of plants when irrigations were more frequent e.g. frequent irrigation, mean height of 40 plants 1) to leaf tip, (18 to 46 days), 55 to 210 cm.; normal, 55 to 202 cm.; 2) to tassel (46 to 67 days), — frequent, 158 to 274 cm.; normal, 151 to 266 cm.

III. WEEKLY MEASUREMENTS AS RESULT OF SOWING EXPERIMENTS. — The normal time for planting maize in Egypt is towards the end of July. In 1919, however, sowings were made from the beginning of April until the end of September and weekly observations were made of the growth and development of the plants throughout the season. The variety employed was the Bahtim "Surecropper", long season semi-dent variety.

Growth and development curves are given for the various sowing dates; these correspond with the figures given. The physiological development of the plants shows the same characteristics in the curves of leaf development, tasselling, silking and maturation. These features are also brought out according to the isophytic diagram. The best growing conditions for the maize plant in Egypt are evidently to be found late in July and during the month of August. The amount of growth, including time for germination in the first 21 days after planting, shows how far temperature plays a part in determining the rate of development of the maize plants. Germination in the case of the April sowing took place in 12 days, in the May sowing it was 10 days, while in July sowings the time is normally 5 or 6 days. Although the mean temperature at the end of August is about the same as early in June, the night temperatures are more favourable than at the earlier period. The following table shows the comparative

yields of maize sown at different periods and the heights at 21 days after planting.

Date of sowing	Comparative yield * of grain	Height of plant	Temperatures (°C.) Average for 21 days		
			Maximum	Minimum	Mean
April 1	56	24.6 cm	29.6	11.4	20.5
May 1	63	25.1	30.4	12.2	21.3
June 1	84	43.5	33.7	14.8	24.2
June 15	88	51.7	34.7	16.2	25.4
June 29	92	61.6	36.8	17.4	27.1
July 13	100	69.1	36.3	18.7	27.5
July 27	96	62.2	35.5	18.5	27.0
August 10	86	59.1	35.7	18.5	27.1
August 24	—	62.8	33.3	17.1	25.2
September 7	64	51.9	31.7	15.4	23.5
September 21	39	—	—	—	—

(*) Maximum yield in sowing of July 12 being taken as 100.

From a consideration of the mean weekly maximum and minimum temperatures at Bahim (April to November), it seems clear that the optimum growing weather in Egypt for maize occurs during the month of August; at this time night temperatures are higher than at any other time of the year and during the day time the effects of water strain on the plants is likely to be much less in evidence than during the month of July.

25 - The "Pure Line" and the "Pure Chain": a Contribution to the Terminology of Genetics. — PRELL, G., in *Zeitschrift für induktive Abstammungs- und Vererbungslehre* Vol. XXVI, Parts 3-4, pp. 287-294. Leipzig, July 1921.

PLANT
BREEDING

The term "pure line", in the sense in which it is used by JOHANNSEN, should be employed exclusively for groups of individuals derived from an autogamous stock by means of repeated self-crossing. It is however often used also to designate groups of genetically isolated individuals derived from two allogamous parents. The necessity of finding a distinct and suitable term for this second class of individuals has long been felt and the author proposes the expression, "pure chain", ("reine Kette").

Thus we have:

Pure Line. — The entire group of individuals descended from a single autogamous, homozygous stock.

Pure Chain. — The entire group of individuals descended from two allogamous stocks which are isogeneous (isozygotes and homozygotes), only as regards sex and the characters with which they are possibly connected (heterozygotes only as far as sex is concerned).

The two groups differ in the number of diplonts (diploid numbers of chromosomes) necessary to their formation and in the nature of the

relations existing between the haplonts (haploid numbers of chromosomes), that unite to form the diplont. In pure lines, the point of departure is a single diplont, and the whole genealogical tree can correctly be represented as a simple *line*. On the other hand, the pure chain starts from two diplonts, so that in the genealogical development, there are two diplont forms that constantly coalesce and separate according to the same rule, thus producing the exact image of a *chain*.

The haplonts of a pure line are identical, from the genetic and typical standpoint, whereas the haplonts of the chain differ in the factor or group of factors of sex. The contrast between the line and the chain is specially noticeable when there are other morphological factors united to those of sex; in this case, the heterozygotism of a diplont is accentuated.

26 - Study of Barley Hybrids, Especially from the Standpoint of Fixity of the Segregation of Characters in the F_2 . — BLARINGHEM, L., in *Annales de la Science agronomique*, Year 38, Series 6, No. 4, pp. 177-230. Paris, August 1921.

The visible morphological characters of barley grain are indices which allow varieties suitable for the brewery to be distinguished from those suitable for cropping. These characters are regularly transmitted in a large number of lines and can be used as a test of the botanical purity of each kind.

The author gives the results of a series of experiments relating to two characters 1) hairs on axis of spikelet: *stiff* (A), or *downy* (a); 2) lateral dorsal veins of the seed: *rough* (B), or *smooth* (b). These two pairs of characters behave as independent Mendelian units in crosses between pure form of the variety *Hordeum distichum nutans*.

HAIRS ON AXIS OF SPIKELET. — The pair Aa obeys the Mendelian law in 29 crosses (with 110 F_1 hybrids and 5422 F_2 hybrids), between varieties belonging to the Linnaean species, *Hordeum distichum*, *H. nudum* and *H. tetrastrichum*. In every case and in all the combinations, the ratio of stiff-haired to downy-haired individuals in the F_2 was as 3 : 1. This cha-

TABLE I. — Segregation in the F_2 Generation
of Crosses between Forms of *H. distichum nutans*.

Crosses	Total number of F_2 plants	Plants with	
		Stiff hairs	Downy hairs
0.185 ♀ × 0.431 ♂	39	32	7
0.236 ♀ × 0.431 ♂	343 (344)	262 (258)	81 (86)
0.385 ♀ × 0.190 ♂	27	21	6
0.431 ♀ × 0.185 ♂	36	26	10
0.431 ♀ × 0.185 ♂	23	15	8
0.431 ♀ × 0.236 ♂	406 (408)	304 (308)	102 (102)
Totals . . .	874 (880)	660 (660)	214 (220)

racter therefore manifests itself independently of the nature of the above-mentioned 3 species upon which it is possible by means of suitable crossings to impress at will the character of stiff hairs or downy hairs respectively.

It remains to be seen whether these characters are of any importance from the industrial, agricultural or commercial standpoints.

The same numerical relations are found in the crosses: *H. distichum nutans* × *H. distichum erectum*, *H. distichum* × *H. nudum* and *H. distichum* × *H. tetrastichum*.

TABLE II. — Segregation in the F_2
of Crosses between Forms of *H. distichum nutans* (1909).

Crosses	Total number of F_2 plants	Plants with	
		rough veins	smooth veins
Bohemia ♀ × 0.236 ♂	524 (520)	392 (390)	132 (130)
0.236 ♀ × Bohemia ♂	629 (640)	481 (480)	148 (160)
0.185 ♂ × 0.236 ♂	47	30	11
0.185 ♀ × 0.131 ♂	39	29	10
0.131 ♀ × 0.185 ♂	36	33	5
0.131 ♀ × 0.185 ♂	24	15	8
Totals . . .	1298 (1300)	986 (975)	312 (325)

DORSAL VEINS. — The pair Bb on the other hand behaves somewhat differently from the pair Aa. These characters are only independent in the variety *Hordeum distichum nutans* (which includes all the best brewing barleys), and solely in the 1906 crosses. In the F_2 , individuals with rough veins and smooth veins occur in the ratio 3 : 1.

On the other hand much segregation is already found in the crosses made in 1907 (all between forms of *H. distichum nutans*) as is shown in Table III

Similar cases of segregation occurred in 1908; the author suggests, that they may be explained by the greater plasticity of Chevalier II, Hannechen, and the lines 0.190, 0.385 and 0.219 as compared with the lines 0.236, 0.431 and the form Bohemia. If this is the case the pair of characters *presence* — *absence of bristles* would be a more significant association in proving the fixity of the lines than the pair *stiff hairs* — *downy hairs*. This seems to be proved by the behaviour of the hybrids arising from crosses between 0.501 (line of *H. distichum erectum* with smooth veins), and 0.631 (line of *H. distichum erectum* with rough veins). In fact, in the F_2 of crosses made in 1906, in the neighbourhood of Paris, the ratio of bristly individuals to smooth individuals was not as 3 : 1, but as 1 : 1, as if the lines 0.501 and 0.631 were fixed hybrids. In the crosses effected in 1906 out of the 91 (92) individuals of the F_2 , 42 had rough and 49 had

TABLE III. — Segregation in the F_2
Generation of Crosses Between Forms of *H. distichum nutans* (1907).

Crosses	Total number of F_2 plants	Plants with	
		rough veins	smooth veins
0.190 ♀ × 0.236 ♂	550 (552)	463 (414)	87 (138)
0.431 ♀ × 0.385 ♂	100 (100)	79 (75)	21 (25)
Totals	650 (652)	542 (489)	108 (163)
0.109 ♀ × Chevalier II ♂	48	30	18
0.219 ♀ × Hannchen ♂	27	16	11
0.219 ♀ × Bohemia ♂	115	69	46
Totals	100 (192)	115 (144)	75 (48)

smooth veins, instead of 69 and 23, as there should have been theoretically according to the ratio 3:1.

The crosses made in 1907 between the same lines, 0.631 and 0.521, gave on the contrary different results; in F_2 , the general ratio was 3:1 but there were individual variations, such as had not been observed among the former hybrids. Similar results were again produced in the case of cross 0.190 × 0.631 (and 0.631 × 0.190): the progeny in the F_2 dividing into 3 groups with very different ratios of segregation.

1st group = 3:1
2nd " = 1:1
3rd " = 9:7 or 15:1

The difference in the results observed from one year to another deserves notice, as it always occurred in the same types. The essential factor of genetic instability is to be found in line 0.631 (and perhaps also to some extent in 0.190), but the author maintains that it is owing to the genetic instability of these types that the environment, and more especially the climate are able to alter the percentages (ratios).

This instability would manifest itself in the following manner in the crosses: supposing that 0.631 has a hybrid origin as regards the presence or absence of bristles, and that A (presence), is constantly dominant over a (absence). In this case, the uniformity and homogeneity characteristic of 0.631 would depend upon the condition that all the egg-cells with the character A were fertilised by a pollen, and reciprocally that all the a egg-cells were fertilised by pollen A. Crossing the heterozygous line 0.631 (Aa) with the homozygous line 0.190 (aa) gives the following combinations:

I	pollen. . . A	a	or	v	II	pollen. . . a	A
	ovule. . . a	a				ovule. . . A	a

which gives *Aa*, *aA* hybrids (with bristles), and *aa aa* hybrids (smooth) in the proportion of 1 : 1, just as was found in the progeny of the 1906 hybrids and in the 1908 group, *Cistercienne* \times *Bohemia*.

This proportion was found in half the cases examined.

The great homogeneity observed in **0.631** is due to prolonged selection under determined (climatic) conditions of environment. Now it is quite possible that the same conditions of growth would act upon **0.631** \times **0.190** in a manner quite different from that in which they would act upon **0.631**, and that the regular fertilisation of all the **0.631 A** ovules with **a** pollen (and reciprocally), would undergo some modifications (in the cross **0.631** \times **0.190**). Once the equilibrium is disturbed, the segregation ratios become irregular and vary from one year to another according to the variations of the environment that in any way effect the state of equilibrium.

It still remains to be demonstrated whether under given conditions of climate, soil, date of sowing, cultural operations, etc. **0.631** degenerates, in a more or less irregular manner as regards the character of bristles.

Breeding experiments alone can answer this question, and so far, none have been carried out.

It is however well to remember that *Svanhals* and *Primus* barleys, of which the genetic constitution is heterozygous, are fixed in Sweden and Germany, but rapidly degenerate (as regards this very character of bristles), when they are cultivated in dry years in Picardy and in Eure-et-Loir (France).

27 - Studies in Linkage Relations in Maize made in the United States. — EYSTER, W. H., in *Genetics*, Vol. 6, No. 3, pp. 209-240, tables 32, bibliography of 20 works. Baltimore, May 1921.

Results of a systematic search for linkages in maize, especially as regards the two characters tunicate ears (in which the glumes of the ear develop to such an extent that each kernel is entirely enclosed), and sugary endosperm, both dependent on the factor pairs represented as **Tu tu** and **Su su**. In previous tests the author obtained a certain number of reciprocal crosses between the tunicated and sugar heterozygotes (**Tu tu Su su**) and plants non-truncated with non-sugary endosperm (**Tu tu Su su**). The results are shown in Table I. It was estimated that groups **Su Tu**, **Su tu**, **tu tu** would be equal. On the contrary however in every case there was an excess of **Su Tu** and **su tu** respectively over **Su tu** and **su Tu**. The tendency of these factors (**Su** and **Tu**) to remain together in inheritance can be explained by assuming that they are located in the same chromosome. But should this follow a fixed rule, the groups **Su tu** and **su Tu** should be missing. Admitting however the undeniable existence of the linkage between **Su** and **Tu**, the resulting exceptions may be explained by the crossing-over theory (1) viz. a certain number of chromosomes are located between the *locus* of **Su** and the *locus* of **Tu**; the chromosomes of the non-tunicated and non-sugary

(1) See R. Jan. 1918, No. 29, note (1) p. 54. (Ed.)

plant are located in a similar fashion and the result is an exchange between homologous segments which become united to form new chromosomes; these should possess one only of the two characters previously linked together. The more this phenomenon is intensified and frequent, the more often will **Su tu** and **su Tu** be represented. In the case in question, the percentage of crossing over in the two groups of crosses, should amount to 26.94 and 38.85 % respectively.

The rate of crossing-over can neither be designated, fixed or constant; it is readily influenced by prevailing conditions and by genetical factors supplied by the chromosomes.

In megasporogenesis (connected with the formation of egg-cells) the percentage of crossing-over in the case investigated, amounted to 21.1 and 30.5 %, while in microsporogenesis (connected with pollen grains), the average is higher than 8 %.

In a second series of genetical experiments the author has made a special study (using a certain number of selected crosses) of the relations between **Tu** and **Su** and other mutant factors :

- C** = colour of aleurone
- Sh** = shrunken endosperm
- I** = factor opposing the production of colour of aleurone
- Gi** = factor for golden plant
- R** = red aleurone
- B** = brown colour of plant
- Lg** = leaves without ligules
- P** = coloured pericarp
- Pl** = purple anthers
- A** = anthocyanin pigmentation in leaves, and grain
- An** = semi-dwarf plants with anthers on the ears
- Bl** = brown blotches on leaves
- Cr** = crinkled leaves
- D** = dwarf plant
- F** = fine striping in the leaves.
- Fl** = floury endosperm
- J** = *Japonica* striping of leaves
- Pr** = purple aleurone in the presence of other aleurone factor pairs
- Ra** = *ramosa* ear
- Gs** = green striping of leaves
- V** = greenish-white seedling
- W** = white seedling
- Y** = factor concerned in the formation of yellow endosperm

The following data refer to the factor **C** (colour of aleurone). In the cross **Tu tu Cc** × **tu tu cc**, the progeny **Su Tu**, **Su tu**, and **su Tu su tu** are obtained in equal proportions (see Table II), which indicates that **C** is found in a chromosome different from that associated with **Tu** and **Su**. Similar conditions appear to exist in the following cases :

TABLE I. — Linkage between *Tu* and *Su* and intensity of the phenomenon «crossing over».

Pedigree	Su tu	Su tu	su Tu	su tu	Percentage of «crossing-over»
Tu tu Su su × tu tu su su					
196 - 10 × 192 - 4	89	19	31	98	21.10%
198 - 9 × 192 - 3	147	57	63	127	30.46
140 - 4 × E 7595 - 11	90	35	24	70	26.94
Totals . . .	326	111	118	295	26.94%
tu tu su su × Tu tu Su su					
E 7595 - 11 × 140 - 4	26	8	19	25	34.62%
E 8575 - 4 × 201 - 7	78	56	32	86	34.92
Totals . . .	104	64	51	111	34.85%

TABLE II. — Cross *Tu tu Cc × tu tu cc*.

Pedigree	Su Tu	Su tu	su Tu	su tu
362 - 365	31	32	36	36
366 - 367	67	64	83	84
368 - 369	53	53	54	58
370 - 371	54	68	60	69
Totals . . .	205	217	233	247

28 - Type and Variability in Kafir (*Andropogon Sorghum*). — CONNER, A. B., and KARPEN, R. E., in *Texas Agricultural Experiment Station, Agricultural and Mechanical College of Texas, Division of Agronomy, Bulletin No. 279*, pp. 1-14, figs. 6. Brazos County, Texas, April 1921.

The object of this study is to present data as to type and variability of certain characters in *Andropogon Sorghum* resulting from statistical research. The data given are taken from material accumulated from 1915 onwards, involving the measurement of material from crib-run heads and selected population material and from lines successively inbred for single characters. This work was conducted at Texas Agricultural Experiment Station, Substation No. 8, near Lubbock, Texas, a region well adapted to the cultivation of sorghum.

In 1916, 669 crib-run standard blackhull kafir heads were measured and records were made as to:

1) Number of seed-bearing branches ; 2) Length of seed bearing branches ; 3) Number of nodes per head ; 4) Length of rachis or centre stem ; 5) Length of head ; 6) Weight of head ; 7) Weight of threshed grain. In succeeding work with progeny the following additional measurements were taken : 8) Height of plant ; 9) Diameter of plant ; 10) Number of nodes per plant ; 11) Weight of green forage.

The bulletin in question deals however with the first 4 features only. Eighty individual heads were selected for planting in 1917, comprising 8 groups, each group representing one of the extremes of the 4 pairs of characters involved. The selection for the 1918 planting, within a single group, included 10 heads taken from the single row in that group whose progeny conformed to the highest standard for the particular character for which selection was made. Accordingly the selections were made in each generation for a 4-year period. The method of selection adopted is clearly shown in the accompanying diagram. The tabulation of the data for population and for lines inbred for 4 generations is given in the form of tables and graphs, which show the type and variability existing in each population and line from year to year. The tables of statistical constants seem to be quite reliable, judging from the probable error in each case.

The 8 lines involved in every case showed uniformity and purity in the F_2 generation. This is in accordance with the low percentage of cross pollination found by the authors in open-pollinated heads. The practical significance of this fact is two-fold : 1) It lends greater reliability to preliminary uncontrolled breeding work ; 2) It emphasises the value of the head-row method of breeding grain sorghums and gives a greater probability of obtaining pure lines.

The fact that marked progress was made in one only of the 8 lines involved, *viz.* the line selected for few seed bearing branches, emphasises the importance and value of selecting a large number of heads for the initial planting to increase the chances of including superior individuals.

The variability in the several lines, as shown in the tables, is less than in the populations, and is consistently uniform in the F_2 and succeeding generations, further emphasising the purity of the lines in the F_2 generation.

29 - The Interesting Relation between the Appearance of the Globe Mutant in *Datura Stramonium* and the Behaviour of the Chromosomes. -- BLAKESLEE, A. F., in *Genetics*, Vol. 6, No. 3, pp. 241-261. Baltimore, May 1921.

The "Globe" mutant in *Datura Stramonium* is characterised by depressed-globose capsules, by decreased vigour in growth and by the broad and only slightly toothed leaves.

In the *Datura*, the placing and behaviour of the chromosomes are closely associated in relation to the appearance of this mutation and to several others. Consequently there has been noted, in every case, a duplication of chromosomes giving rise to dimorphic gametes with 12 and 13 chromosomes instead of a single normal type with 12. These are called simple trisomic mutants ; in somatic cells one of the 12 sets is a trisome with three homologous chromosomes instead of the normal two.

1) When selfed, the mutant character is passed on to about 22 % of the descendants.

When crossed with a normal as the male parent, the mutant character is transmitted to about 26 % of the progeny. If however the pollen of a mutant is employed, the abnormal character is apparent in only about 2 % of the progeny.

The author has concluded therefore :

a) As a general rule, the mutant complex is transmitted through the egg cells and either not at all or only to a very limited extent through the pollen.

b) By crossing the mutant (♀) with the normal (♂), the number of mutants obtained in the progeny was inferior to that expected, which may be attributed to the lessened vitality of the mutant forms. Selfing continued for 10 generations has not increased the proportion of mutants in the progeny.

2) New Globe mutations under normal conditions have occurred in about 0.05 % of the descendants (1 out of 2000 individuals). The percentage is, however, distinctly higher, in cases which already contain the simple trisomic mutants. It is also higher when the mutant is used as the female parent, but when crossed with normals, there is no increased percentage of mutants in the progeny. It may be concluded therefore that new Globe mutations are caused by changes in the formation of the egg cells and rarely by changes in the pollen.

3) Normal plants show about 2.7 % of defective pollen grains; Globes about 8 %. The pollen sterility is then a characteristic of the Globe, as it is of the other simple trisomic mutants.

30 - Number of Chromosomes in Various Species of *Lactuca* (1). — MITSUHASHI ISHIKAWA, in *The Botanical Magazine*, Vol. XXXV, p. 130. Tokyo, July 1921.

The author has made a special study of the number, behaviour and size of 15 species and 5 varieties of *Lactuca*, several of which are found growing wild in Japan; the figures in brackets indicate the number of chromosomes.

<i>L. laciniata</i>	(9)	<i>L. chelidoniifolia</i>	(5)
<i>L. Raddiana</i>	(9)	<i>L. debilis</i>	(24)
<i>L. trianquilata</i>	(9)	<i>L. stolonifera</i>	(8)
<i>L. Scariola</i> var. <i>sativa</i>	(9)	<i>L. repens</i>	(8)
<i>L. villosa</i>	(9)	<i>L. Matsumurae</i>	(8)
<i>L. Keiskeana</i>	(5)	<i>L. jamaicensis</i>	(8)
<i>L. lanceolata</i>	(5)	<i>L. chinensis</i>	(16)
<i>L. lanceolata</i> var. <i>platyphylla</i>	(5)	<i>L. dentata</i> var. <i>sensuina</i>	(12)
<i>L. denticulata</i>	(5)	<i>L. dentata</i> var. <i>albiflora</i>	(12)
<i>L. denticulata</i> var. <i>pinnatifidula</i>	(5)	<i>L. dentata</i> var. <i>alpicola</i>	(7)

As regards size and shape and number of chromosomes, 5 groups were distinguished, showing differences also of a general taxonomic nature.

(1) See R. Feb. 1918, No. 180. (Ed.)

NAKAI has previously stated, taking as a base the morphological characteristics, that the Japanese species of *Lactuca* may be classified under 4 headings, *Lactuca*, *Crepidiastrum*, *Paraixeris* and *Ixeris*.

It is of interest to note that the two classifications, made according to the two different standpoints (taxonomic and cytologic) are in agreement. *Lactuca* corresponds to group 1, *Crepidiastrum* to group 2, *Paraixeris* to group 3, and *Ixeris* to group 4 and to a fifth group constituted by the author (1).

31 - The "Akala" (*Rubus Macraei* Gray), an Endemic Hawaiian Raspberry and the Possibilities of its Improvement by Hybridisation and Selection. -- ROCK, J. E., in *Journal of Heredity*, Vol. XII, No. 4, pp. 147-150, figs. 3, Washington, April 1921.

The Akala berry grows wild in Hawaii and possesses varying characteristics, which permit a subdivision into several distinct varieties.

In Kanaï, it is an upright spineless shrub, only a few feet in height, with somewhat small, dry berries.

In Maui the plants resemble to a certain extent the typical species from Hawaii, but have more spines and the fruits are less than half the size.

Rubus Macraei prefers the slopes of the high mountains of Hawaii proper (on Hualalai, Mauna Loa and Mauna Kea). The largest fruited specimens were discovered by the author in a volcanic cone, known as Hinakapanulla, situated 6000 ft. high, in a desert lava field. The Akala was found in abundance with *Acacia Koahawaiiensis*, *Coprosma pubens*, *Styphelia tameiameia*, and presented the appearance of a huge liana several feet long and with a woody stem 2 inches in diameter. The berries, of a dark rich purple colour were at least 2 inches in diameter. The plant is completely devoid of spines.

In the fern forests near the volcano of Kilanca there occurs another form of *Rubus Macraei*, also spineless, at least in older plants. This region has been given over to cattle grazing, and consequently the akala has gradually disappeared as a terrestrial plant and only the plants which became epiphytic have survived. These grow in the crevices of trunks and branches of trees and in the forks of moss covered trees. Although smaller than the berries found on the Hualalei and Mauna Kea Islands, they are always over 1 1/2 inches in diameter in spite of the lack of humus and of real soil.

(1) The unit characters to which may be applied or to which there is a tendency to apply Mendelian laws are regulated by the genetic factors in the chromosomes. Recently, the researches made in Japan and the United States (MORGAN etc.) have thrown considerable light on the question of chromosomes in the hereditary sense, and it has been concluded that a parallelism and intimate connection exist between the unit characters of the plant and the behaviour, number and forms of the chromosomes. The characteristics on the one hand and on the other, the chromatic constant which corresponds, constitute the two extreme points of the genetical inquiry. If much has been said and written hitherto concerning the characters, nothing really definite has been arrived at which confirms cytologically the Mendelian principles. It is therefore advisable to keep the plant breeding section well informed as to the most recent investigations on this subject. (Ed.)